1990
AMENDMENTS
to the
Program of Studies for Junior High Schools

i) Replace Contents page.

ii) SCIENCE: Insert new Science sections A. B. C. and D.

Retain old program until September 1991.

iii) PRACTICAL ARTS: Replace all Computer Literacy sections A. B. C. and D. with Computer Studies sections A. B. C. and D.

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Program of Studies for Junior High Schools

1990 CONTENTS

COURSES	A. Rationale and Philosophy	B. General Learner Expectations (Goals and Objectives)	C. Specific Learner Expectations (Content)	D. Learning Resources
HEALTH AND PERSONAL LIFE SKILLS	1987	1987	1987	1987
LANGUAGE ARTS	1984	1984	1987	1987
MATHEMATICS	1988	1988	1988	1988
PHYSICAL EDUCATION	1988	1988	1988	1988
SCIENCE (Old program) (New program)	1984 1990	1984 1990	1984 1990	1986 1990
SOCIAL STUDIES	1989	1989	1989	1989
FINE AND PERFORMING ARTS				
Art	1984	1984	1984	1986
Drama	1989	1989	1989	1989
Music	1988	1988	1988	1988
PRACTICAL ARTS				
Agriculture: Land and Life	1989	1989	1989	1989
Computer Studies	1990	1990	1990	1990
Home Economics	1988	1988	1988	1988
Industrial Education	1984	1984	1984	1986
Typewriting	1984	1984	1984	1986
RELIGIOUS OR ETHICAL STUDIES				
Ethics	1989	1989	1989	1989
SECOND LANGUAGES				
French	1985	1984	1984	1986
German	1984	1984	1984	1984
Ukrainian	1984	1984	1984	1985

The dates in the grid indicate the most current and up-to-date sections in each Program of Study.

SCIENCE

A. PROGRAM RATIONALE AND PHILOSOPHY

"The aim of education is to develop the knowledge, the skills and the positive attitudes of individuals, so that they will be self-confident, capable and committed to setting goals, making informed choices and acting in ways that will improve their own lives and the life of their community."

Secondary Education in Alberta, 1985

Science education contributes to this overall aim of education in several ways:

- first, by providing learning experiences that help students understand and interpret the world in which they live
- second, by developing knowledge, skills and attitudes that support the intelligent and responsible application of science and technology
- third, by developing a foundation of knowledge, skills and attitudes that support further study of the sciences.

To achieve these purposes, the Junior High Science Program provides a broad range of learning experiences in the biological, physical and earth sciences. In continuity with the elementary and senior high programs, the junior high program provides opportunity for study of most of the major branches of science, building on the experiences of the elementary school and providing a foundation for more formal studies at the senior high level.

Experiences from previous years of schooling and from outside the school contribute to science learnings at this level. In extending their learning, students are increasingly challenged to interpret their experiences and examine patterns and relationships within them. Studies of materials proceed with increasing attention to specific attributes and with greater focus on accuracy and precision. In the senior high years this learning will be further extended through the development of theoretical explanations, examination of inferred relationships and the application of mathematical models.

In keeping with the developmental level of students, concepts are introduced through a broad range of experiences, including those based on first-hand investigation. Attention is also given to the development of information, accessing and researching skills, and the use of technological materials (e.g., computers and interface devices). Learnings based on these experiences are extended as students are given opportunities to reflect on their experiences, learning to discover and construct meaning through careful and focused thought. Learning activities are thus designed not only to illustrate established science ideas, but also to allow students to construct new meanings and find new applications for what they learn.

Note that as of September 1990, the revised Grade 7 program begins its provincial implementation and replaces the previous program. For Grades 8 and 9, the revised program may be implemented in September 1990 and must be implemented in September 1991.

The content of the program is presented in contexts that illustrate the development and application of science. Frequent attention is given to the processes by which scientific knowledge is gathered, largely by involving students directly in the practice of scientific inquiry. Significant attention is also given to other contexts of science, in particular the application of science to the solution of practical problems, and the examination of the implications of science and technology with respect to personal and social impacts. The processes of problem solving and decision making are given direct attention in learning activities: students are thus involved in ways that will stimulate their critical and creative thinking skills.

The program design is based on an integrated approach to science education, in which opportunities are provided to explore different fields of science at each grade level. The integrated nature of the program is also reflected in the inclusion of topics that span traditional science disciplines; this provides opportunities to apply learnings to new areas of study. Specific content has been selected so as to provide for the sequencing of concept, skill and attitude development and to allow students to explore some areas at progressively greater depths.

In broad terms, the intended outcome of the secondary science program is the development of a scientifically literate citizenry. A scientifically literate person is one who:

- demonstrates a working knowledge and practical understanding of the sciences
- has the ability to evaluate scientific evidence
- understands the processes by which scientific knowledge is developed and can adapt those processes for personal use
- applies science concepts, theories and processes as appropriate to the investigation of everyday problems
- understands the relationship between science and technology
- demonstrates awareness of how science and technology can function responsibly in a social context
- recognizes the limitations as well as the usefulness of science and technology in advancing human welfare
- demonstrates a continuing interest in science and technology.

B. GENERAL LEARNER EXPECTATIONS

These general learner expectations are to be developed through the program as a whole, with particular attention to be given in designated units, as identified in individual unit outlines.

Attitudes listed in this section are at a general level and have application to all units. In cases where a unit presents significant opportunities for development of a particular attitude, that attitude is also identified in the individual unit outline, often in greater detail. In some cases unit outlines also identify additional attitudes that are to be achieved in that unit only.

All of the skills that are to be developed through the units are listed in this general section. Particular applications of these skills and opportunities for their development will be identified in the unit outlines.

Concepts identified here are at a general level and apply to the program as a whole. These concepts have to do with the general nature of science, the relationship between science and technology, and the application of science and technology to personal and public decision making. Concepts outlined here are not repeated in the individual units; concepts listed in the individual units identify specific content knowledge to be developed in that unit.

General learner expectations are listed in association with three major areas of emphasis:

Nature of Science
Science and Technology
Science, Technology and Society.

Concepts, skills and attitudes have been identified for each of these three areas of emphasis as well as for specific units at each grade level. Note that each area of emphasis provides an overall context for learning basic scientific concepts and principles related to students' experiences. One of these contexts provides the primary basis for the development of each unit in the program.

NATURE OF SCIENCE

Attitudes

Students will be encouraged to develop:

1. Curiosity about events and objects in the natural world.
2. Appreciation of the beauty and complexity of the natural world.
3. Respect for accuracy and precision.
4. Honesty and completeness in reporting and evaluating observable data.
5. Open-mindedness in considering alternative ideas and interpretations.
6. Critical-mindedness in evaluating inferences and conclusions.
7. Confidence in personal ability to design and conduct a scientific investigation.
8. Respect for the safety of themselves and others through careful and considerate scientific practice.

Science Inquiry Skills

Students will demonstrate:

1. Questioning
   - recognizing patterns and discrepant events
   - identifying and asking relevant questions
2. Proposing Ideas
   - hypothesizing
   - predicting
3. Designing Experiments
   - identifying and controlling variables
   - developing procedures
4. Gathering Data
   - observing
   - measuring
5. Processing Data
   - organizing and presenting data
   - identifying patterns and trends
6. Interpreting Data
   - inferring
   - developing theoretical explanations

Concepts

Students will demonstrate an understanding that:

1. Science is a disciplined way to develop explanations for natural phenomena.

2. Scientific knowledge is cumulative and subject to change.

3. Significant aspects of the scientific enterprise include:

    - observable data that can be repeatedly demonstrated in various places, at different times, by different investigators
    - experimentation (scientific inquiry) as a means to support, modify, or reject proposed ideas about natural phenomena
    - interpretations and conceptual inventions that are theoretical in nature.

SCIENCE AND TECHNOLOGY

Attitudes

Students will be encouraged to develop the following attitudes:

1. Appreciation of the need for technological devices and processes to serve human needs.

2. Appreciation of the contribution of science to the solution of practical problems.

3. Awareness of alternatives in the approach to technological problems.

4. Respect for the creative and critical thinking processes.

5. Appreciation of good design taking into consideration function, safety, aesthetics and environmental effects.

6. Willingness to take the initiative in dealing with practical problems.

7. Confidence in personal ability to solve practical problems.

Technological Problem-Solving Skills

Students will demonstrate the following skills:

1. Understanding the Problem

    - identifying the purpose
    - identifying specific requirements (specifications)

2. Developing a Plan

    - identifying alternatives
    - planning and designing

3. Carrying Out the Plan

    - testing the design
    - troubleshooting

4. Evaluating

    - evaluating the design
    - evaluating the planning process

Concepts

Students will demonstrate an understanding that:

1. Science and technology are interrelated:

    - the development of new technologies may open new areas for scientific investigation
    - solving technological problems frequently involves the application of scientific knowledge.

2. Technology is a process of solving practical problems

3. Significant aspects of the technological problem-solving process include:

    - approaching the problem in a planned way
    - development of a practical design as a means to support, modify, or reject alternative ideas for solving the problem
    - creativity and inventiveness in developing solutions that achieve the intended purpose
    - critical thinking in evaluating potential solutions and suggesting improvements.

4. Technological development involves both products and processes.

5. Technologies arise from common practices and traditions as well as from the creative applications of scientific knowledge.

SCIENCE, TECHNOLOGY AND SOCIETY

Attitudes

Students will be encouraged to develop the following attitudes:

1. Appreciation of the need for informed decision making at both personal and societal levels.

2. Appreciation of the contributions and limitations of scientific and technological knowledge to the societal decision-making process.

3. Confidence in using scientific and technological knowledge for informed personal decision making.

4. Commitment to the pursuit of knowledge and the responsible application of that knowledge.

5. Appreciation of different perspectives that bear upon the societal decision-making process (e.g., scientific, technological, personal, social, environmental and economic).

6. Respect for the perspectives and viewpoints of others.

Decision-Making Skills

Students will demonstrate the following skills:

1. Identifying the Issue

2. Identifying Alternatives

3. Researching

   - identifying and evaluating related scientific knowledge
   - identifying perspectives on each alternative
   - identifying consequences of each alternative

4. Reflecting and Deciding

   - considering consequences
   - considering perspectives
   - building consensus

5. Taking Action

   - demonstrating responsibility through personal action
   - demonstrating responsibility through actions as a member of a group

6. Evaluating

   - evaluating effects of actions
   - evaluating the decision-making process used

Concepts

Students will demonstrate an understanding that:

1. Knowledge of science and technology helps inform the societal decision-making process.

2. Societal decision making aims at choosing actions most appropriate for existing circumstances, by comparing and evaluating the consequences of alternative proposals.

3. The societal decision-making process works toward building a consensus. Significant aspects of societal decision making include:

   - recognition of the advantages and limitations of scientific and technological knowledge for informing the process
   - consideration of other perspectives (e.g., economic, personal, social, environmental), in addition to scientific and technological perspectives, in informing decision making about science related issues
   - deliberation as a means to clarify, support, modify, or reject alternative proposals for action
   - recognition of the need for trade-offs in order to achieve workable solutions in science-technology-society problems.

4. Relationships among science, technology and societal decision making occur at many levels:

   - developments in science and technology often significantly impact on society
   - societal needs and concerns often stimulate or influence technological problem solving and scientific inquiry.

5. Many of the effects of science and technology on society are unforeseen at the time decisions have to be made.

C. SPECIFIC LEARNER EXPECTATIONS

1. TOPICS OF STUDY

The program is comprised of six units at each grade level. Each unit focuses on a particular science topic and develops a learning context that contributes to the students' overall understanding of science and technology.

The instructional time for each unit varies, but each level of the program is based on 100 hours of instructional time.

2. REQUIRED/ELECTIVE COMPONENTS

Each unit of the program has a required component and an elective component, defined as follows:

The **required** component encompasses the knowledge, skills and attitudes that all students should be expected to acquire. This component comprises 80% of the program.

The **elective** component, which comprises 20% of the program, provides opportunities to adapt and enhance instruction to meet the diverse needs, abilities and interests of individual students. It encourages enrichment and remediation consistent with the content and objectives of the required component.

The program content for both the required component and the elective component is defined by the same statements of objectives.

3. OPTIONAL CONTENT

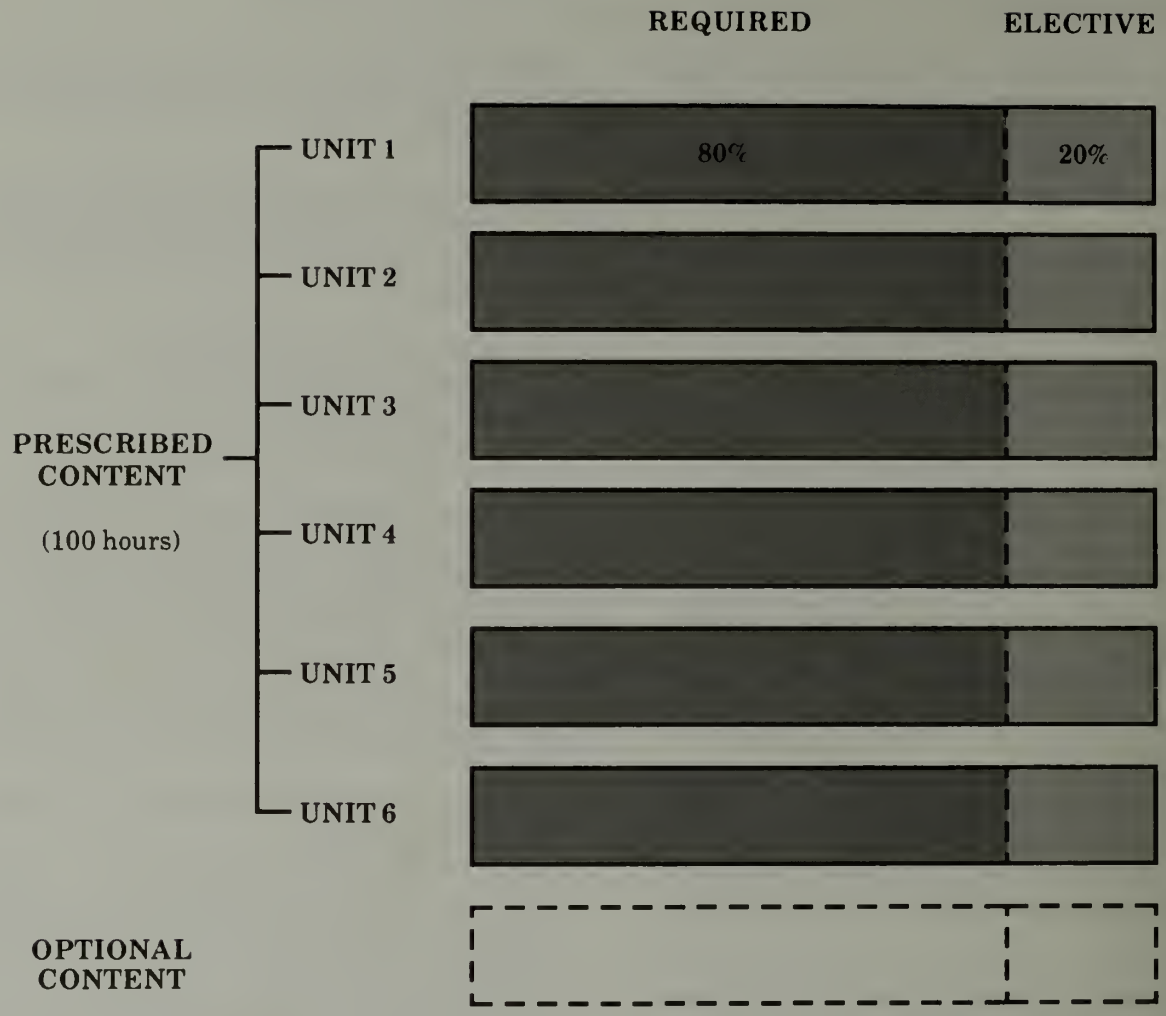
Note: There will be no requirement that optional content be included within a school's Junior High Science Program.

Instructional content that is provided beyond the mandatory 100 hours of instruction shall be deemed to be optional. Optional content to the program may take several forms:

- an extension of a prescribed unit
- a suggested option identified in the *Teacher Resource Manual* (TRM)
- an option based on local choice.

Selection of topics for development as optional units may be made at the local school level, based on local needs and resources. To assist the school in the choice and development of topics, brief outlines will be provided in the TRM and, where available, resources will be identified. Optional topics may include units that have been developed or selected locally, subject to the following provisions being met.

- All program content must support the overall goals of the program.
- Inclusion of optional content must not detract from the achievement of required program objectives or from elective content associated with the required program.
- Optional content must not duplicate or unduly overlap content to be developed in a subsequent year of the secondary science program.


REQUIRED
ELECTIVE
UNIT 1
80%
20%
UNIT 2
UNIT 3
PRESCRIBED CONTENT
(100 hours)
UNIT 4
UNIT 5
UNIT 6
OPTIONAL CONTENT

GRADE SEVEN PROGRAM

1. Characteristics of Living Things

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and regarding the relationship among science, technology and society.

This unit provides a study of living things that builds on concepts, skills and attitudes developed at the elementary level. Opportunities are provided in this unit to reinforce and develop science inquiry skills, with particular emphasis on observation, organizing and presenting data, and experimental design.

Throughout the unit, students are expected to view living things either through direct observation or through the interpretation of pictorial material. Observational studies of organisms will focus on patterns and relationships with attention given to the study of structures, functions and adaptations. Learning about structures in living things will be further developed in the unit Structures and Design which follows.

A wide range of organisms may be chosen as examples for study. Studies of the human body are included in this unit, with a particular focus on monitoring and measuring.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Appreciation of the beauty and complexity of living things.
2. Commitment to the care of living things.
3. Appreciation of the adaptive value of structural and behavioural characteristics of plants and animals.
4. Confidence in personal ability to design and conduct a scientific investigation of living plants and animals.
5. Awareness of techniques for monitoring life functions.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. Questioning
   - recognizing patterns and discrepant events
   - identifying and asking relevant questions
2. Proposing Ideas
   - hypothesizing
   - predicting
3. **Designing Experiments**
   - **identifying and controlling variables**
   - **developing experimental procedures**
4. **Gathering Data**
   - **observing living things**
   - **observing and measuring**
     - **lung capacity**
     - **breathing and heart rates**
     - **responses to stimuli**
5. **Processing Data**
   - **organizing and presenting data**
     - **classifying materials as living and non-living**
   - identifying patterns and trends
6. **Interpreting Data**
   - inferring the relationship of living things to their environments
   - **inferring the value of adaptations based on observations of living things**
   - developing theoretical explanations

CONCEPTS

1. The study of living things is based on observation, classification and interpretation.

   Students will be expected to:

   - recognize the role of observation, classification and interpretation in the scientific study of living things

- distinguish between living and non-living things on the basis of observable characteristics
- identify and describe characteristics of living things: in particular their ability to grow and reproduce; their ability to respond to environments; and their ability to produce or take in food
- identify and describe similarities among groups of living things
- identify and describe differences among groups of living things
- recognize and describe variation within groups of living things.

2. The concept of life cycle provides a basis for interpreting change in living organisms.

   Students will be expected to:

   - describe and give examples of the concept of life cycle
   - describe and compare different life cycles
   - describe patterns of growth and development within organisms.

3. The concept of adaptation provides a basis for interpreting the structures and behaviours of living things.

   Students will be expected to:

   - identify examples of adaptive structures
   - describe animal adaptations for one or more specific purposes (e.g., locomotion, reproduction)
   - describe plant adaptations for one or more specific purposes
   - recognize and evaluate the adaptive value of external features of specific plants and animals studied
   - identify examples of adaptive behaviours.

4. The concept of stimulus and response is used in interpreting the behaviour of organisms in relation to changing environmental conditions.

   Students will be expected to:

   - identify examples of stimulus-response patterns in the behaviour of organisms
   - recognize and describe responses of the human body to changing environmental conditions
   - recognize responses to specific environmental conditions
   - distinguish between instinctive and learned responses.

2. Structures and Design

OVERVIEW

The major emphasis of this unit is on science and technology. Opportunities are also provided to support learning regarding the nature of science and the relationship among science, technology and society.

This unit provides an introduction to the study of natural and human-built structures. Students will observe design in a variety of situations and infer general patterns and principles relating to those designs. In examining these structures, attention is given to the function of the overall structure and to the function of individual components. The scientific study of materials is also introduced in this unit.

Frequent opportunities are provided for students to apply their ideas about structures to the solution of practical problems. Throughout the unit, students are involved in design and construction activities using simple materials; these activities develop the skills of technological problem solving.

The use of alternative materials and approaches is important to this study. Students learn to evaluate alternative approaches in terms of their overall effectiveness. In so doing, they come to appreciate that there may be more than one solution to a problem and that there is value in considering alternative approaches. Social, environmental and aesthetic considerations are also taken into account in this study.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Appreciation of functional value of good design.
2. Appreciation of aesthetic value of good design.
3. Awareness and appreciation of the role of safety in good design.
4. Awareness and appreciation of variation in design in providing multiple alternative solutions to given problems.
5. Appreciation of the presence of similar principles of design in both natural and manufactured things.
6. Confidence in personal ability to design and build a safe functional structure.

SKILLS

Students will demonstrate the following technological problem-solving skills, with emphasis on those skills that appear in boldface:

1. Understanding the Problem
   - identifying the purpose of a construction
   - identifying specific requirements (specifications)
2. **Developing a Plan**
   - **identifying alternative design solutions to building a load-bearing structure**
   - **planning and designing a load-bearing structure**
3. **Carrying Out the Plan**
   - **testing the design by constructing a load-bearing prototype, using materials such as cardboard or wood**
   - **troubleshooting the design: identifying and correcting weaknesses in the structure**
4. **Evaluating**
   - **evaluating the design**
   - **evaluating the planning process**

CONCEPTS

1. Design can be observed in both natural and human-constructed materials.

   Students will be expected to:

   - identify patterns of organization in natural materials
   - recognize stems and skeletons as structural components of living things
   - infer the function of plant and animal structures
   - identify patterns of organization in human-constructed materials
   - recognize similarities in natural and human-constructed structures.

2. Structures are designed in response to human needs, purposes and aspirations.

Students will be expected to:

- infer and describe the function of human-made structures (e.g., shelter, containment, support)
- recognize examples of ways in which human aspirations have been achieved through the design and construction of structures.

3. Alternative approaches are considered in the design of human-constructed structures.

Students will be expected to:

- recognize common approaches to the design of bridges and buildings
- distinguish between rigid and non-rigid structures
- infer the purpose of components in human-made structures
- recognize examples of various materials being used for the same design function
- recognize the relationship between choice of materials and the design used.

4. Knowledge of materials and structural principles can contribute to the design process.

Students will be expected to:

- describe processes for testing the strength of materials
- measure and compare the strength of materials
- distinguish between tensile and compressive forces
- identify points of tension and compression in a structure
- describe the potential effects of tensile and compressive forces on different components of a structure
- recognize the role of ties and linkages in adding to the overall strength and stability of a structure
- describe the effects of the use of different shapes on the strength and stability of materials
- identify the function of hinged components in natural and human-made materials
- describe the function of different kinds of hinged components.

5. Selection of material and a design is based on many considerations.

Students will be expected to:

- identify environmental implications of design decisions
- recognize costs to be considered in design decisions
- recognize the need to balance functional, aesthetic, economic and environmental concerns.

6. Designs may need to accommodate specialized needs or environmental conditions.

Students will be expected to:

- identify differences in requirements of structures built on earth and in space
- recognize similarities and differences in approaches to construction used on earth and in space.

3. Force and Motion

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit provides students with the opportunity to study a variety of forces and examine the effects of those forces on objects and materials. For the most part, the unit uses an observational and experimental approach. Students learn to recognize and measure forces, then focus on the effects of those forces within different systems and in different applications. The focus on measurement and on specific applications is a common feature between this unit and the Temperature and Heat Measurement unit which follows.

A study of the causes and effects of friction, and a study of motion in space are also included within this unit.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of the need for specialized science terminology (i.e., to distinguish between force and mass).

2. Appreciation of current technologies used in measuring force and mass.

3. Awareness of the pervasiveness of frictional forces in natural and human-made systems.

4. Appreciation of technologies used to reduce friction.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. Questioning

   - recognizing patterns and discrepant events
   - identifying and asking relevant questions

2. **Proposing Ideas**

   - hypothesizing
   - **predicting consequences of forces**

3. **Designing Experiments**

   - **identifying and controlling variables**
   - **developing procedures**
     - **selecting and/or developing appropriate techniques for measuring forces and masses**

4. **Gathering Data**

   - **observing the effects of forces**
   - **measuring**
     - **measuring forces and masses**
     - **estimating forces and masses**

5. **Processing Data**

   - organizing and presenting data
   - **identifying patterns and trends**

6. **Interpreting Data**

   - **inferring force and motion relationships**
   - developing theoretical explanations

CONCEPTS

1. Forces are observed indirectly; the presence of a force can be inferred from its effects.

   Students will be expected to:

   - infer the application of a force based on observed movements (mechanical effects)
   - describe the direction of a force
   - identify examples of mechanical, frictional, electrostatic, magnetic and gravitational forces (including buoyant force)
   - describe the effects of these forces.

2. Forces can be compared and measured by various means.

   Students will be expected to:

   - identify appropriate means for detection and measurement of different kinds of forces

- identify and describe the principles on which various kinds of force measurement devices are based
- recognize and use units of force (newtons).

3. The gravitation force on an object is identified as its weight. The weight of an object can be found to vary according to the gravitational field in which the weight of the object is measured.

   Students will be expected to:

   - recognize and describe the effects of gravitational force
   - describe changes in gravitational force that result from a change of position in space (e.g., decrease in gravitational force as a space vehicle moves away from the earth).

4. The concept of mass has been developed to identify a characteristic of an object that is constant for that object, regardless of its gravitational frame of reference.

   Students will be expected to:

   - identify appropriate means of measuring mass
   - distinguish between mass and weight
   - recognize and use units of mass (i.e., grams and kilograms)
   - identify differences in scientific and everyday approaches to identifying the mass of an object.

5. Relative motion of objects is affected by forces that act between those objects. Motions of objects can be interpreted or predicted based on knowledge of forces.

   Students will be expected to:

   - describe and predict the pathways of moving objects
   - describe and predict changes in movement that result from the application of forces
   - identify evidence and effects of friction
   - identify factors that affect friction
   - describe methods of increasing or decreasing frictional forces
   - describe movement of materials in space environments
   - identify action-reaction pairs
   - identify forces in action-reaction pairs.

4. Temperature and Heat Measurement

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and regarding the relationship among science, technology and society.

This unit examines the effects of temperature and heat changes with particular attention to approaches to measurement.

In introductory activities, students examine the effects of temperature change on various materials. The knowledge gained in these activities is then applied to practical problems of temperature measurement. The need for accuracy and the need for specialized thermometers for various applications are considered. Effects of heating and cooling of water are noted and a concept of heat as being distinct from temperature is introduced. Attention is also given to determining the quantity of heat energy in different foods and fuels. The uses of different sources of heat are considered.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Respect for precision in measurement.
2. Appreciation of human ingenuity and skill in the development of technologies used in measurement (focus on temperature measurement).
3. Recognition of the need for specialized instrumentation for specific applications.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. Questioning
   - recognizing patterns and discrepant events
   - identifying and asking relevant questions
2. Proposing Ideas
   - hypothesizing
   - predicting
3. **Designing Experiments**
   - identifying and controlling variables
   - **developing procedures**
     - **selecting and using appropriate instruments for measuring temperature**
4. **Gathering Data**
   - **observing the effects of heat on materials**
   - **measuring**
     - **estimating temperature**
     - **selecting and using appropriate instruments for measuring temperature**
     - **measuring temperature**
5. **Processing Data**
   - **organizing and presenting data**
   - **identifying patterns and trends**
6. **Interpreting Data**
   - **inferring**
   - **developing theoretical explanations**

CONCEPTS

1. The temperature of a substance provides a measure of its relative hotness or coldness compared with an arbitrary temperature scale.

   Students will be expected to:

   - infer temperatures based on physical properties of materials (e.g., colour, physical state)
   - describe temperatures of materials in descriptive non-quantitative terms.

2. The need for precision in temperature measurement has led to the development of thermometers and temperature scales.

Students will be expected to:

- infer the need for precise temperature measurement in given applications
- infer the accuracy of a temperature measuring device
- describe the Celsius temperature scale and identify significant temperatures on that scale (e.g., melting and freezing point of water, body temperature)
- calibrate a thermometer
- estimate temperatures of materials in degrees Celsius.

3. Thermal expansion and contraction provides the basis for thermometry.

Students will be expected to:

- predict changes in materials due to heating and cooling (i.e., expansion and contraction, change of state)
- compare the amount of thermal expansion for different materials
- describe the components of liquid thermometers and the functions of those components
- describe the operation of liquid and air thermometers in relation to the design of the devices and the principles by which they operate
- describe the operation of various specialized thermometers in relation to their design and the principles by which they operate.

4. The scientific concept of heat is used to describe the thermal energy in a material.

Students will be expected to:

- recognize that when the temperature of a substance increases, the substance has absorbed heat; when the temperature of a substance decreases, the substance has lost heat
- estimate final temperature of a mixture of equal quantities of a liquid of different temperatures
- recognize that the final temperature of liquid mixtures is affected by the mass and heat-related characteristics of the original components
- distinguish between the concept of temperature and the concept of heat
- describe temperature and heat in terms of particle motion.

5. Heat energy can be derived from a number of sources.

Students will be expected to:

- identify sources and methods of generating heat (e.g., mechanical, chemical, electrical)
- identify advantages and disadvantages of the use of various heat sources
- recognize that different fuels may have a different heat energy content
- compare the energy content of different fuels (e.g., wood, coal, natural gas)
- compare energy content of different foods.

5. Micro-organisms and Food Supplies

OVERVIEW

The major emphasis of this unit is on science, technology and society. Opportunities are also provided to support learning regarding technologies and the nature of science.

This unit examines the means by which food supplies are maintained safely for human consumption. It focuses on personal and public decisions that affect the safety of food supplies. Scientific and technological developments are presented as background, providing a basis for knowledgeable decision making and action.

Within the unit, students are involved in observational studies of organisms and become aware of the kinds of micro-organisms found within a wide range of habitats. This study leads to an examination of the technologies used in food preparation and preservation. Particular attention is given to identifying and evaluating alternative technology, and to the issues, decisions and standards relating to the safe handling of food.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of the widespread distribution of micro-organisms.
2. Awareness of the role of scientific knowledge and technologies in maintaining a healthy food supply.
3. Recognition of the need for safety standards to prevent the spread of disease through food.
4. A safety attitude regarding the selection, preparation and handling of food materials.

SKILLS

Students will demonstrate the following decision-making skills, with emphasis on those skills that appear in boldface:

1. **Identifying issues regarding the safe handling of food.**
2. **Identifying alternative approaches to the handling and processing of food.**
3. **Researching**
   - **examining background information about alternative technologies for eliminating disease-causing organisms from food supplies**
   - **identifying perspectives on each alternative**
   - **identifying consequences of each alternative**
4. **Reflecting and Deciding**
   - **considering consequences**
   - **considering perspectives**
   - **building consensus**
5. **Taking Action**
   - **demonstrating responsibility through personal actions**
   - demonstrating responsibility through actions as a member of a group
6. Evaluating
   - evaluating effects of actions
   - evaluating the decision-making process used

CONCEPTS

1. There is need for personal and public decision making regarding the safe handling of food.

   Students will be expected to:

   - identify practical difficulties in the management of food supplies
   - identify and describe diseases that commonly result from improper food handling.

2. Micro-organisms are found in a variety of habitats.

   Students will be expected to:

   - describe variations in size, shape and movement of micro-organisms

- identify natural habitats of micro-organisms
- identify habitats of micro-organisms in human-made environments and materials
- describe examples of micro-organisms that cause disease in humans
- identify factors that enhance or inhibit the growth of micro-organisms.

3. Micro-organisms play significant roles in relation to human food supplies.

   Students will be expected to:

   - identify examples of the use of micro-organisms in food production (e.g., use of yeast in bread making and use of bacterial cultures in the making of yogurt)
   - describe the role of micro-organisms as decomposers
   - describe changes in food materials as it supports the growth of a mould culture
   - recognize micro-organisms as the prime agent of food spoilage
   - identify significant food-borne pathogens.

4. Technologies for the preservation of human food involve various approaches to the elimination of micro-organisms and to safe containment of uncontaminated food.

   Students will be expected to:

   - identify unsafe food-handling procedures
   - describe food-handling procedures that help assure the safety of food supplies
   - identify and describe technologies used in the preparation, preservation and protection of food for human consumption
   - identify potential problems as well as benefits in food-preservation procedures.

5. The determination of appropriate food-handling procedures necessitates both personal and public decision making.

   Students will be expected to:

   - recognize that the safe processing and handling of food involves the cooperative effort of many people in many different roles
   - identify factors that might contribute to the lack of safety at various stages of food handling
   - infer the need for safety standards regarding food-handling procedures
   - identify specific areas in which standards need to be established
   - identify regulatory agencies responsible for monitoring food-handling procedures and products
   - identify the role of science in the setting and enforcement of safety standards
   - recognize that various perspectives (including scientific, economic, environmental, ethical, societal and personal) may need to be considered in decisions regarding the setting and enforcement of a standard
   - describe personal actions in ensuring the safety of personal food supplies.

6. Evidence of Erosion

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit examines changes in the surface of the earth that result from the erosion, transport and deposition of earth materials.

The unit provides insights into the scientific study of earth changes. Students observe a variety of mechanisms by which gradual changes occur, then consider the cumulative effect of the changes over long periods of time. This long-term view is applied to the interpretation of local landscapes.

Students are given opportunities to predict the impact of geological changes on human-built structures and human-modified environments. Consideration is given to related problems and issues that arise.

Note: In this unit, attention is focused on changes that involve weathering, erosion, transport and deposition of materials; the Grade 8 unit on the earth's crust focuses on those forces that lead to mountain building and plate movement.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness and appreciation of the effects of geological change over long periods of time.
2. Respect for the power of geological forces.
3. Appreciation of the dependence of humankind on the physical earth.
4. Awareness of the impact of humankind on the physical earth.
5. Appreciation of the need to incorporate a knowledge of geological change in long-term land-use planning.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. Questioning
   - identifying and asking relevant questions
   - defining problem statements
2. **Proposing Ideas**
   - hypothesizing
   - **predicting (based on extension of current trends and changes)**
3. Designing Experiments
   - identifying and controlling variables
   - developing procedures
4. **Gathering Data**
   - **observing**
   - **measuring**
     - **size of sediments**
     - **rates of stream flow**
5. **Processing Data**
   - organizing and presenting data
   - **identifying patterns and trends**
6. **Interpreting Data**
   - **inferring causes of phenomena observed**
   - developing theoretical explanations

CONCEPTS

1. The study of ongoing changes to the earth's surface provides the basis for scientific interpretation of current landforms.

   Students will be expected to:

   - recognize ongoing processes of earth change
   - distinguish between rapid and gradual changes
   - recognize long-term effects of gradual changes

- infer processes that have led to major erosional features.

2. Various forms of weathering provide mechanisms for breaking down earth materials.

   Students will be expected to:

   - recognize evidence of weathering
   - describe mechanical, biological and chemical processes of weathering
   - identify factors that may contribute to the rate of weathering.

3. Erosion causes the breakdown and movement of earth materials.

   Students will be expected to:

   - recognize evidence of erosion
   - identify wind, water and ice as agents of erosion
   - recognize sediments as materials that have been transported by wind, water or ice
   - recognize erosion and deposition as start points and end points in the transport of materials by wind, water and ice
   - describe and classify sediments
   - relate the sediment load of a stream to its volume and rate of movement
   - observe and describe changes in shorelines that result from erosion or deposition
   - observe and describe changes in river courses (e.g., meandering) that occur as a result of long-term erosion and deposition
   - observe and describe changes in stream profile as a river system ages.

4. Movement of water occurs below as well as at the surface of the land.

   Students will be expected to:

   - observe and interpret the porosity of different earth materials
   - predict groundwater flow based on the slope and porosity of earth materials.

5. Earth materials may be transported by glaciers.

   Students will be expected to:

   - describe the accumulation, movement and melting processes of glaciers
   - identify the range and location of glaciers, past and present
   - infer glacial presence and movement from landscape features.

6. Earth changes that result from erosion and transportation of materials can be predicted and, to some extent, controlled.

   Students will be expected to:

   - predict the effects of gradual geological changes acting over long periods of time
   - infer susceptibility to erosion (based on slope, subsurface composition and surface cover)
   - recognize and describe methods for controlling erosion
   - identify potential problems in the siting of buildings in relation to landscape features that are undergoing geological change.

GRADE EIGHT PROGRAM

1. Solutions and Substances

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit provides an introductory study of solution chemistry. Unit activities engage students in the scientific investigation of different kinds of chemical solutions and their properties. Through these activities, students learn the basic principles of solubility.

Opportunities are also provided to examine practical problems in solution chemistry, in particular, problems in the separation of materials into their component substances.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Appreciation of the extent to which solutions are a part of living things, natural products and manufactured products.

2. Awareness and appreciation of crystalline structures in solid materials.

3. Awareness of solution chemistry as a practical science.

4. Confidence in personal ability to investigate material properties and processes.

5. Awareness of potential dangers of handling unknown materials.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. Questioning

   - recognizing patterns and discrepant events
   - identifying and asking relevant questions

2. **Proposing Ideas**

   - **hypothesizing relationships between variables**
   - **predicting based on extrapolation of trends**

3. **Designing Experiments**

   - **identifying and controlling variables**
   - **developing experimental procedures**

4. **Gathering Data**

   - **observing**
   - **measuring solubility of materials**

5. **Processing Data**

   - **classifying materials according to their solubility**
   - **organizing and presenting data**
   - **charting data**
   - **graphing data**

6. **Interpreting Data**

   - **inferring the solubility of different materials based on laboratory tests**
   - **inferring the effect of varying conditions** (e.g., variation in temperature and particle size) **on the solubility of materials**
   - developing theoretical explanations

CONCEPTS

1. Solutions can be found in many forms, both in natural and human-made materials.

   Students will be expected to:

   - distinguish between a substance and a mixture
   - distinguish between homogeneous mixtures (solutions) and heterogeneous mixtures
   - identify examples of aqueous and non-aqueous solutions
   - identify examples of solutions in natural and human-made materials.

2. Solutions can be described in terms of their composition, their concentration and their physical properties.

Students will be expected to:

- distinguish between solute and solvent
- identify solute and solvent in various kinds of solutions
- describe and give examples of the concept of solubility
- describe the concentration of a solution in both general terms and in numeric terms (e.g., grams per litre)
- describe the effects of various solutes in aqueous solution on the properties of that solution (e.g., physical appearance, freezing point, boiling point).

3. The solubility of materials and the rate at which materials dissolve are found to vary with solution conditions.

Students will be expected to:

- recognize that the amount of a solute that will dissolve in a given solvent generally has an upper limit (saturation point)
- compare the solubility of different materials by laboratory test
- recognize and describe the effect of temperature on solubility of materials
- distinguish between solubility and rate of dissolving
- recognize and describe the effect of temperature on the rate of dissolving
- recognize and describe the effects of particle size on the rate of dissolving
- recognize and describe the effects of mechanical movement on the rate of dissolving.

4. Knowledge of solubility can be applied to the separation of materials.

Students will be expected to:

- identify procedures that can be used for the separation of mixtures into their components, and describe the principles on which they are based (e.g., settling, filtration, evaporation distillation, crystallization)
- apply techniques of filtration
- describe and carry out specific techniques for recovery of solutes from aqueous solutions (e.g., evaporation, distillation, crystallization)
- identify and describe examples of the separation of solutes from solutions (e.g., desalinization of water).

2. Energy and Machines

OVERVIEW

The major emphasis of this unit is on science and technology. Opportunities are also provided to support learning regarding the relationship among science, technology and society.

This unit provides a study of mechanical systems with a focus on their efficiency and effectiveness. The concepts of systems and subsystems are introduced in the unit; these concepts provide a basis for interpreting mechanical devices in this unit and are applied to a variety of technologies in later units.

Opportunities are provided in the unit for students to construct devices that will perform given functions and to make improvements to those devices. In the process, students consider the need for efficiency in design and they become aware of the practical approaches to the conservation of energy. An awareness of the various forms of energy and energy conversion is also developed within this unit.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness that practical problems can often be solved in multiple ways.

2. Respect for the diversity of approach exhibited by others in their search for solutions to practical problems.

3. Confidence in personal ability to solve practical problems.

4. Awareness of the role of safety and efficiency in good design.

SKILLS

Students will demonstrate the following technological problem-solving skills, with emphasis on those skills that appear in boldface:

1. **Understanding the Problem**

   - **identifying the purpose**
   - identifying specific requirements (specifications)

2. **Developing a Plan**

   - **planning and designing a mechanical device that will accomplish a specific task through the application and transfer of energy**
   - **identifying alternative design solutions in the building of a mechanical device**

3. **Carrying Out the Plan**

   - **testing the design by constructing a simple mechanical device**
   - **troubleshooting the design: identifying and correcting practical problems in a mechanical device**
     - **identifying problems due to excessive friction**
     - **identifying problems in the fit or meshing of moving parts**
     - **improvising practical remedies for problems encountered**
     - **identifying potential hazards**

4. **Evaluating**

   - **evaluating the design**
   - evaluating the planning process

CONCEPTS

1. Mechanical devices can be understood as systems that are made up of subsystems and components.

   Students will be expected to:

   - identify parts or components of some simple mechanical devices (e.g., mechanical pen, stapler)
   - identify parts of a mechanical device that work together as a subsystem.

2. Mechanical systems are designed to perform one or more functions.

Students will be expected to:

- identify the functions of some common mechanical devices
- identify the contribution of subsystems to the overall function of a mechanical device
- identify the contribution of individual components to the function of a mechanical device
- identify components that operate as simple machines within a mechanical device (e.g., lever and wheel and axle as examples of simple machines found within a hand-operated can opener)
- describe the operation and application of simple machines
- describe the bicycle as an example of a mechanical system
- compare alternative designs of a mechanical device (e.g., compare propulsion systems in toy cars).

3. Transmission of power between different parts of a system can be accomplished through various kinds of linkages.

Students will be expected to:

- identify the source of power in some familiar mechanical devices (e.g., electrical sources, fuel sources)
- identify power linkages within a mechanical system (e.g., belt driven and gear driven systems)
- analyze a gear system to identify the effect of different gear ratios on relative speeds of a driving and driven shaft
- build or adapt a mechanical system to provide for different turning ratios between a driving and a driven shaft.

4. Mechanical systems convert energy from one form to another.

Students will be expected to:

- identify examples of energy conversion
- identify modifications to a device that would enable it to use more than one form of energy input (e.g., spring driven device converted for operation with an electric motor).

5. The efficiency of mechanical devices often can be improved through changes in design and by alterations that reduce friction.

Students will be expected to:

- construct a device that makes efficient use of energy
- identify changes in the design of a mechanical device that would improve its overall efficiency (i.e., changes that would reduce the number of moving parts or reduce friction)
- identify improvements in the design of a mechanical device that would improve its safety and ease of operation
- improve the efficiency of a device by troubleshooting
- interpret information on energy efficiency of different devices or products (e.g., fuel consumption of automobiles, electrical power consumption of household appliances)
- identify impacts of inefficient energy use on environments and resources (e.g., depletion of resources, problems in disposal of waste heat).

3. Consumer Product Testing

OVERVIEW

The major emphasis of this unit is on science, technology and society. Opportunities are also provided to support learning regarding technologies and the nature of science, technology and society.

This unit provides for a study of consumer product testing, with a focus on the social need for safe, reliable and effective products. The need for quality information that will serve individual and public decision making is the overall context for this study.

Through sample investigations and the study of textual materials, students learn the basics of experimental design for product testing. Results of investigations are then considered in relation to the process of decision making, including personal decisions concerning the selection of products and societal decisions about what should be allowed in the marketplace. In sample studies, students consider various criteria for decision making including economic and environmental considerations as well as product effectiveness. An introduction to the setting of standards is also a part of this unit.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of environmental impacts of consumer products.

2. Awareness that a product may be safe to use in one application but dangerous to use in another.

3. Awareness that products may affect different individuals in different ways.

4. Confidence in personal ability to evaluate a product based upon evidence and scientific principles.

SKILLS

Students will demonstrate the following decision-making skills, with emphasis on those skills that appear in boldface:

1. **Identifying issues and concerns regarding the development of consumer products that are safe, reliable and make appropriate use of resources.**

2. **Identifying alternatives in the design of consumer products.**

3. **Researching**

   - **designing experiments to test consumer products**
   - **identifying, examining and evaluating information about alternative products**
   - **examining personal, social, economic and environmental perspectives on each alternative**
   - **identifying consequences of each alternative**

4. **Reflecting and Deciding**

   - **considering alternatives**
   - **considering perspectives**
   - **building consensus**

5. **Taking Action**

   - **demonstrating responsibility through personal actions**
   - demonstrating responsibility through actions as a member of a group

6. **Evaluating**

   - **evaluating effects of actions**
   - **evaluating the decision-making process**

CONCEPTS

1. Consumer products each have a variety of characteristics which might be considered in evaluating the quality and effectiveness of the product.

   Students will be expected to:

   - distinguish between product characteristics that are significant to the primary function of a product and those characteristics that are not
   - identify consumer expectations regarding the function and effectiveness of given products
   - recognize safety, reliability and durability as significant product characteristics
   - recognize variations in product quality (i.e., variations in performance characteristics, variations in composition or components)
   - analyze ways in which a sample product might fail and identify areas where defects might occur.

2. Product testing provides profiles of significant characteristics that can assist those making decisions regarding the product.

   Students will be expected to:

   - recognize the importance of unbiased testing and evaluation of results through the use of control samples and blind tests
   - identify the kind of tests that might be carried out to evaluate a particular product claim
   - design and carry out tests of selected characteristics of a particular product
   - design and carry out a controlled investigation in which two or more products are compared with respect to selected characteristics
   - evaluate methods used to test products
   - describe the use of product test information at various stages of decision making (e.g., product development stage, quality control, consumer selection)
   - identify the kinds of information that can assist consumer decisions regarding a product (e.g., information regarding product performance, safety, reliability and durability).

3. Standards are required to ensure that products are safe and meet minimum consumer expectations.

   Students will be expected to:

   - identify qualities and/or performances of a product for which standards might be set (i.e., standards for safety, reliability, durability and specific performance expectations)
   - explain the need for standards in packaging, labelling and advertising (relative to consumer needs for appropriate and accurate product information)
   - describe the responsibility of producers and marketers in ensuring that advertisements are consistent with actual product characteristics
   - recognize product characteristics that may be required for particular applications or for particular consumers (e.g., on the basis of physical characteristics, allergies and disabilities)
   - identify conditions that are relevant to the safe use of sample products (e.g., maximum load, need for ventilation, temperature requirements).

4. Decisions regarding consumer products involve consideration of alternatives and implications.

   Students will be expected to:

   - identify impacts of the production, use and disposal of products on environments and on living things in those environments (e.g., alteration or elimination of habitats, addition of pollutants)
   - identify examples of health and safety problems that might occur through use of consumer products
   - identify impacts of particular products on individuals and on society
   - identify decisions that need to be made at a personal and at a societal level (e.g., decisions regarding acceptability of products and how products are used)
   - recognize the contribution of scientific information to effective decision making regarding consumer products.

4. The Earth's Crust

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit investigates features of the earth's crust that can be interpreted through examination of earth materials and formations.

Building on concepts, skills and attitudes developed in the Grade 7 Evidence of Erosion unit, students consider ongoing processes of earth change, with a particular focus on changes that lead to the formation of new rocks and new formations. Volcanic action, earthquakes and crustal movements are considered in this connection.

Earth materials are studied both from the perspective of examining individual rocks and rock groups and by a study of the formations in which rocks are found. The fossil record is introduced and its usefulness in interpreting earth changes is considered.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness and appreciation of the effects of geological change over long periods of time.
2. Respect for the power of geological forces.
3. Appreciation of the dependence of humankind on the physical earth.
4. Awareness of the role of theory in interpreting earth changes.
5. Confidence in personal ability to interpret geological materials and changes.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. **Questioning**
   - **recognizing patterns in changes to the earth's surface**
   - **identifying and asking relevant questions**
2. **Proposing Ideas**
   - **hypothesizing relationships between observed characteristics of earth materials and the processes that may have caused them**
   - **predicting based on interpretation of present changes**
3. Designing Experiments
   - identifying variables
   - developing procedures for observation and investigation
4. **Gathering Data**
   - **observing rock formations**
   - **observing landforms and changes**
   - **measuring**
5. **Processing Data**
   - **classifying materials according to simple characteristics** (e.g., classification of minerals on the basis of hardness, fracture, cleavage)
   - **organizing and presenting data**
6. **Interpreting Data**
   - **inferring relationships between observed earth changes and processes that may cause these changes**
   - developing theoretical explanations

CONCEPTS

1. Evidence of earth changes can be found through observation of ongoing changes and by interpretation of surface features.

   Students will be expected to:

   - describe evidence for and physical effects of earthquakes
   - describe patterns in earthquake distribution
   - recognize and interpret examples of folding and faulting
   - interpret patterns in the structure and distribution of mountain formations (with particular emphasis on western North America)
   - describe the structure and development of fold and fault mountains
   - identify and describe examples of ongoing crustal movements (e.g., movement of Pacific plate relative to North American plate)
   - interpret patterns in crustal movement (e.g., relationship to continental boundaries and mid-ocean ridges)
   - locate general distribution of volcanoes on a world map
   - describe the structure and development of volcanoes
   - interpret volcanic features and materials (e.g., pumice, obsidian, basalt, granite)
   - interpret the relationship between earthquake locations, the distribution of volcanoes on the earth's surface and crustal movements.

2. Rock characteristics can be interpreted in relation to the formations in which they are found.

   Students will be expected to:

   - identify common rocks by observation and simple tests (e.g., texture, foliation, striation, crystal size)
   - identify component materials in common rocks (e.g., sand grains as components of sandstone; quartz, mica and feldspar as components of granite)
   - recognize and interpret examples of major rock groups (i.e., igneous, metamorphic and sedimentary)
   - interpret rock composition and structure in relation to processes of rock formation and change.

3. Sedimentary rock formations provide a basis for interpreting earth changes.

   Students will be expected to:

   - recognize sedimentary rock formations
   - describe processes by which sediments accumulate and sedimentary rocks are formed
   - describe hypotheses regarding fossil formation
   - identify the portions of living things that are most likely to be preserved by fossilization
   - identify kinds of rocks where fossils are likely to be found
   - recognize and interpret examples of fossils
   - infer general characteristics of some organisms based on fossil remains
   - describe patterns in the appearance of different life forms as indicated by the fossil record
   - recognize the basis on which the relative age of rock formations is interpreted
   - recognize the major divisions of the geological time scale.

5. Growing Plants

OVERVIEW

The major emphasis of this unit is on science and technology. Opportunities are also provided to support learning regarding the nature of science and regarding the relationship among science, technology and society.

This unit has a technological focus. General features of plants, their structures and their functions are studied; this knowledge is then applied in specific applications for plant growth and propagation. Human actions and interventions that can enhance plant growth are highlighted, as well as actions that affect the variety and distribution of plants.

Throughout the unit, students are provided with opportunities to conduct plant observation and growth activities. These activities provide first-hand knowledge of plant culture and care.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Respect for living things.
2. Confidence in personal ability to nurture healthy plants.
3. Appreciation of the various roles of plants in sustaining human life.
4. Appreciation of challenges faced by farmers and others involved in agribusiness.
5. Awareness that the distribution and growth of plants is very much affected by human interventions and environmental modifications.
6. Awareness of potential hazards as well as the benefits that result in the use of herbicides and pesticides.
7. Awareness that the survival and distribution of many plant forms is in jeopardy.

SKILLS

Students will demonstrate the following technological problem-solving skills, with emphasis on those skills that appear in boldface:

1. **Understanding the Problem**
   - **identifying plant growth problems**
   - **identifying desirable plant characteristics**
2. **Developing a Plan**
   - **identifying alternative techniques that might be used to meet plant needs**
   - **developing a plan for testing the effectiveness of alternative techniques for plant growth**
   - **selecting procedures for planting and growth that take advantage of available conditions and materials**
3. **Carrying Out the Plan**
   - conducting a test of alternative methods of plant growth
   - **troubleshooting plant growth problems:**
     - **identifying problems due to inappropriate environmental conditions**
     - **identifying problems resulting from diseases or pests**
     - **improvising practical remedies for problems encountered**
4. **Evaluating**
   - **evaluating methods of plant propagation and culture**
   - **evaluating the planning process**

CONCEPTS

1. Plant breeding leads to the development of plants with specialized characteristics.

   Students will be expected to:

   - identify desirable plant characteristics (e.g., yield, hardiness, adaptability to different conditions)
   - interpret the adaptive and economic value of different plant characteristics
   - describe the use of selective breeding in the production of new plant varieties.

2. Plant propagation may be carried out by use of vegetative processes as well as by use of seed.

Students will be expected to:

- identify and describe flower parts and their functions (e.g., functions of pistil, stamens, ovary)
- conduct a germination study and compute the germination rate based on results obtained
- describe the propagation of plants by vegetative techniques (e.g., leaf or stem cuttings)
- describe patterns of growth for plants, both at the macroscopic and the cellular level.

3. Life processes of plants are carried out by specific plant structures.

Students will be expected to:

- describe and interpret life processes of plants (i.e., osmosis, transpiration, gas exchange, photosynthesis). **Note**: This item requires a general understanding of the processes named, but does not require knowledge of specific biochemistry
- identify and describe structures of vascular plants that enable plants to grow and to carry out life processes
- interpret variation in the structure and function of plant roots and leaves
- predict and interpret responses of plant structures to varying environmental conditions (e.g., responses to variation in light and moisture).

4. Soil characteristics can be enhanced or degraded.

Students will be expected to:

- identify soil components and nutrients
- describe the functional value of soil components relative to plant needs
- describe characteristics of different kinds of soils (e.g., composition, water retention characteristics)
- identify practices that may enhance or degrade soils in particular applications (e.g., tillage techniques, use of crops to stabilize or to enrich soil).

5. Plant growth can be modified by controlling environmental conditions.

Students will be expected to:

- describe the growth of a plant, using both qualitative and quantitative observations
- compare growth patterns of two or more plants
- compare growth requirements of two or more plants
- design an investigation in which plant growth is observed in relation to variation in growth conditions. This investigation may focus on (but is not limited to) the following:
  - manipulation of light conditions: photoperiod, intensity of light, quality of light to suit needs of plants
  - addition of measured quantities of fertilizers and/or growth supplements to plants
  - growth of plants in hydroponic solution.

6. Plants react to changing environmental conditions and to the actions of various pests and diseases.

Students will be expected to:

- identify and interpret abnormalities in plant growth
- infer possible causes of ill health in plants observed
- describe and interpret the consequences of the application of plant herbicides, pesticides or biological controls
- identify alternatives for pest control and describe the relative merits of these alternatives in a particular application.

6. Interactions and Environments

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit engages students in the scientific study of living things in relationship to their environments.

Food and energy transfer within environments is examined, leading to a study of specific roles of organisms within their physical and biological environment. Relationships of organisms to abiotic factors are studied, as well as relationships within the biotic environment. The effects of human interventions such as pesticides, herbicides and pollutants are also considered.

Scientific ideas developed in this unit anticipate themes to be developed in the Grade 9 units Diversity of Living Things and Environmental Quality.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of the complex interrelationships among living things and their environments.
2. Awareness of the nature and extent of impacts on environments caused by human actions.
3. Awareness of the need to monitor and manage environments.
4. Concern and commitment for the maintenance of life-supporting environments.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. **Questioning**
   - **recognizing patterns and discrepant events**
   - **identifying and asking relevant questions**
2. **Proposing Ideas**
   - **hypothesizing relationships among specific living things**
   - **hypothesizing relationships between specific living things and abiotic conditions of their environment**
   - **predicting the effects of given abiotic conditions on the health and distribution of living things in an environment**
3. **Designing Experiments**
   - identifying and controlling variables
   - **developing experimental procedures**
4. **Gathering Data**
   - **observing living things in their environments**
   - **observing the distribution of living things in environments**
   - measuring
5. **Processing Data**
   - **classifying living things within a study plot (in formal classification only)**
   - **organizing and presenting data**
6. **Interpreting Data**
   - **inferring evidence of relationships among living things**
   - **inferring the effect of environmental conditions on the distribution of living things in an environment**
   - **developing theoretical explanations**

CONCEPTS

1. Environments can be described in terms of abiotic conditions.

   Students will be expected to:

   - identify, observe and measure abiotic factors in environments (e.g., temperature, moisture, available light)
   - classify and describe an environment in terms of the abiotic factors that characterize it.

2. The interdependence of living things is evident in the interactions of organisms with each other and with their environments.

   Students will be expected to:

   - interpret distribution patterns of living things within their environments (e.g., interpret the distribution of a specific organism in relation to its nutrient source or its predator's distribution)
   - interpret plant and animal behaviours that indicate dependencies for food or for other needs
   - recognize examples of parasitism, commensalism and mutualism
   - classify animals within an ecosystem as producers, consumers or decomposers
   - recognize food chain relationships within an ecosystem
   - identify energy flows within an ecosystem.

3. Within environments, specialized forms of life can often be found. The environmental needs of these living things can be inferred from their distribution and from their life habits.

   Students will be expected to:

   - identify and describe habitats and microhabitats
   - recognize specializations that are appropriate to organisms in particular habitats (e.g., specialized mouth parts, surface coverings)
   - identify niches within an environment
   - identify examples of variation in light, soil and temperature needs of organisms
   - predict the effect of minor changes in characteristics of an animal or plant on its ability to survive in a given environment (e.g., changes in surface covering, colouration, relative size/shape of appendages)
   - predict the effect of changes in environmental conditions on the ability of particular plants and animals to survive in that environment (e.g., changes in temperature or moisture).

4. Environmental interventions can be found to have both intended and unintended consequences.

   Students will be expected to:

   - identify intended purposes and consequences (positive and negative) of human activities in local environments
   - predict consequences of selective addition or removal of living things from an environment
   - predict consequences of the addition of pesticides, herbicides or other pollutants to an environment
   - describe the effects of food chains and food pyramids on the concentration of pollutants in living things.

GRADE NINE PROGRAM

1. Diversity of Living Things

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit surveys the diversity of living things, using scientific observation and classification as the basis for interpretation. It examines variability in structures and functions of organisms, with particular attention to the adaptive value of those features. The role of variation in behaviour is also examined. Natural and artificial selection are identified as processes that can alter the diversity of living things through the development or extinction of species.

Learning developed in this unit extends ideas introduced in the Grade 8 Interactions and Environments unit and will contribute to learning in the Grade 9 Environmental Quality unit.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness and appreciation of the diversity of life forms.
2. Awareness and appreciation of the interrelatedness of life forms.
3. Recognition that systems of classification and nomenclature are human inventions (rather than something inherent in the materials being classified).
4. Appreciation of the usefulness of classification systems.
5. Awareness of the effects of human actions in increasing or decreasing the diversity of living things.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. **Questioning**
   - **recognizing patterns and discrepant events**
   - **identifying and asking relevant questions**
2. **Proposing Ideas**
   - **hypothesizing about the relationships among specific living things**
   - **hypothesizing about the adaptive value of plant and animal structures**
   - **predicting adaptive responses of plants and animals**
3. Designing Experiments
   - identifying variables
   - developing experimental procedures
4. **Gathering Data**
   - **observing variation within a group of living things**
   - **identifying and describing distinctive features of organisms**
   - **observing and describing the distribution of living things in an environment**
   - measuring (where appropriate) to describe features of living things
5. **Processing Data**
   - **classifying familiar objects or living things, using a dichotomous key**
   - **organizing and presenting data**
6. **Interpreting Data**
   - **inferring evidence of relationships among living things**
   - **inferring risks of extinction based on characteristics of particular living things and knowledge of changing environmental conditions**
   - **interpreting variation of living things**
   - **developing theoretical explanations**

CONCEPTS

1. Living things show a diversity of structural and behavioural adaptations.

   Students will be expected to:

   - demonstrate awareness of the diversity of forms of life
   - observe and identify examples of variation in the structure of living things
   - identify animal structures that play a role in locomotion, securing of food, and avoidance of predators
   - identify plant structures that serve needs for obtaining and distributing nutrients, reproduction and protection
   - infer environmental conditions for which particular structures are adaptive
   - identify and describe examples of mutual dependency between plants and/or animals
   - identify and describe examples of mimicry in plants and animals
   - identify and describe examples of adaptation to a single food source or to a narrow range of food sources.

2. Artificial selection provides a basis for the enhancement of desired characteristics of domesticated plants and animals.

   Students will be expected to:

   - describe the process of selective breeding
   - describe the use of selected breeding to enhance desired characteristics of a plant or animal.

3. The concept of natural selection provides a basis for interpreting the evolution and extinction of species.

   Students will be expected to:

   - identify and describe examples of specialization within related groups of organisms (e.g., specialization for particular food sources, specialization for protection)
   - identify evidence that has led to the concept of natural selection
   - describe the role of natural selection in evolutionary theory.

4. Classification of living things is based on similarities and differences among organisms.

   Students will be expected to:

   - describe the Linnaean classification system
   - identify advantages of using the Linnaean classification system as the basis for scientific classification (as opposed to the use of common names)
   - identify the taxonomic levels used in scientific classification (knowledge of the system of classification is required, not the detailed taxonomy of specific organisms)
   - define the term "species", and identify problems in its interpretation
   - infer the relatedness of species on the basis of their scientific classification
   - describe the contribution of research to expanding the number of known species and to scientific knowledge of those species
   - recognize that growth in scientific knowledge has led to the development of classification systems based on more than two kingdoms.

5. Individual living things can be interpreted as members of groups of organisms that share common features.

   Students will be expected to:

   - identify general features of major groups of living things (e.g., skeletons and exoskeletons, specialized organs, limbs)
   - identify and describe life cycles of plants and animals.

2. Fluids and Pressure

OVERVIEW

The major emphasis of this unit is on science and technology. Opportunities are also provided to support learning regarding the nature of science and the relationship among science, technology and society.

This unit provides an introduction to the properties of fluids and examines the applications of fluids within the natural world and in technological devices. Fluid technologies to be studied include those that involve the movement of fluids and those that involve transfer of mechanical force. Opportunities are provided in the unit for students to construct devices that will perform specified functions and to make improvements to those devices. Students examine approaches used in existing technologies and consider alternatives in their design.

Ideas of systems and control, which were first introduced in the Grade 8 Energy and Machines unit, are applied here as well as in following units.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness that practical problems can often be solved in multiple ways.
2. Confidence in personal ability to solve practical problems.
3. Respect for the diversity of approach exhibited by others in their search for solutions to practical problems.
4. Appreciation of the aesthetic and functional values of aerodynamic and hydrodynamic design.
5. Awareness of the presence of fluids as part of living things, environments and technological devices.

SKILLS

Students will demonstrate the following technological problem-solving skills:

1. **Understanding the Problem**
   - **identifying the purpose of a hydraulic device**
   - **identifying specific requirements (specifications)**
2. **Developing a Plan**
   - **designing a device or system that will accomplish a specific practical task through application of fluid principles**
   - **identifying alternative design solutions in the building of a device or system**
3. **Carrying Out the Plan**
   - **testing a design by construction of a device or system**
   - **troubleshooting a design: identifying and correcting practical problems in a fluid-mechanical device or system**
     - **identifying problems**
     - **improvising practical remedies for problems encountered**
4. **Evaluating**
   - **evaluating the design**
   - **evaluating the planning process**

CONCEPTS

1. Liquids and gases exhibit fluid properties that are significant to their application in technological devices.

   Students will be expected to:

   - describe the compressibility of liquids and gases
   - interpret the compressibility of liquids and gases in terms of particle theory
   - compare the viscosity of different liquids by use of a simple lab test
   - predict the effects of temperature changes on viscosity of fluids
   - recognize flow rates as an indicator of the viscosity of liquids
   - identify applications where viscosity of fluids is a significant factor (e.g., motor oils, sauces)
   - distinguish between applications that require a compressible fluid (gas) and applications that require a non-compressible fluid.

2. Forces within fluids are transferred in all directions.

   Students will be expected to:

   - describe the response of fluids to gravity
   - predict the response of fluids to external pressure
   - recognize the relationship between gravity and buoyancy
   - measure a buoyant force
   - construct and calibrate a simple hydrometer
   - use a hydrometer in measuring the density of a liquid
   - predict changes in liquid density that result from temperature changes and from change in solution concentration
   - predict changes in buoyant force that result from changes in fluid density
   - identify and interpret technologies that are based on buoyant force (e.g., design of ships and submersibles, design of lighter-than-air craft, measurement technologies based on use of hydrometres).

3. Hydraulic systems provide the basis for the application and transfer of forces.

   Students will be expected to:

   - determine the force exerted on a surface based on knowledge of pressure and surface area
   - predict changes in force exerted resulting from an increase in the surface area over which pressure acts
   - explain the need for strength in pressurized vessels.

4. Various technologies are used in the movement and control of fluids.

   Students will be expected to:

   - identify fluid systems in living things and human-made devices
   - interpret the function of fluid systems within living things and human-made devices
   - construct a diagram to illustrate components in a fluid system
   - construct a functional fluid system using materials provided
   - interpret the operation of various kinds of valves
   - interpret the operation of valves in the human heart
   - interpret and explain the operation of pumps.

5. The study of fluid movement has led to development of aerodynamic and hydrodynamic design.

   Students will be expected to:

   - predict the effect of design on drag around an object traveling through a fluid
   - design a streamlined device.

3. Heat Energy: Transfer and Conservation

OVERVIEW

The major emphasis of this unit is on science and technology. Opportunities are also provided to support learning regarding the nature of science and the relationship among science, technology and society.

This unit examines heat energy transfer and related applications. A study of conduction, convection and radiation provides the basis for examination of technologies for the containment of heat energy and for the transfer of heat energy. Particular focus is given to the need to conserve energy resources through efficient use.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of hazards of using flames in proximity to flammable materials.

2. Awareness that practical problems can often be solved in multiple ways.

3. Confidence in personal ability to solve practical problems.

4. Respect for the diversity of approach exhibited by others in their search for solutions to practical problems.

5. Commitment to the conservation of energy resources through efficiency of design and efficiency in energy use.

SKILLS

Students will demonstrate the following technological problem-solving skills:

1. **Understanding the Problem**

   - **identifying the purpose**
   - **identifying specific requirements (specifications)**

2. **Developing a Plan**

   - **identifying alternative approaches to the design of insulated containers**
   - **planning and designing for heat transfer**
   - **planning and designing for insulation**

3. **Carrying Out the Plan**

   - **testing the designs**
     - **construction of an insulated container**
   - **troubleshooting the designs**
     - **identifying and correcting sources of heat loss**

4. **Evaluating**

   - **evaluating the effectiveness of different insulating materials and designs for insulation**
   - **evaluating the planning process**

CONCEPTS

1. The term "heat" is used in reference to energy gained or lost by a material as it interacts with other materials.

   Students will be expected to:

   - recognize heat gain or heat loss in practical activities
   - distinguish between heat and temperature
   - interpret temperature changes in terms of particle theory
   - identify heat losses or gains in terms of number of joules.

2. Heat energy moves from hot bodies to cooler ones.

   Students will be expected to:

   - predict temperature changes that will result from mixing various quantities of water of different temperatures
   - interpret information regarding the specific heats of materials
   - compare the specific heat of solids, liquids and gases.

3. Heat can be transferred by conduction, convection and radiation.

Students will be expected to:

- interpret conduction and convection in terms of particle theory
- compare conduction rates of materials based on experimental data
- identify and interpret applications of heat conduction (e.g., in cooking, heating and insulation)
- predict the flow pattern of a fluid as it is heated
- identify and interpret applications of heat convection (e.g., in cooking, heating and in atmospheric phenomena)
- identify factors that affect rates of radiation (e.g., colour, surface area, temperature)
- identify and interpret examples of heat radiation (e.g., radiant heaters, solar radiation).

4. Heat transfer can be controlled through selection of appropriate materials and by use of appropriate design.

Students will be expected to:

- identify applications in which heat transfer is controlled (e.g., car radiator, clothing)
- design and construct an insulated container
- compare the effectiveness of alternative materials and designs for heat transfer in domestic applications (e.g., in cooking devices and home heating)
- compare the effectiveness of alternative materials and approaches to insulation in domestic applications (e.g., refrigerated containers and insulated homes)
- interpret the effect of clothing materials and design on the retention or transfer of heat
- describe and demonstrate a technique for comparing the effectiveness of different kinds of insulating materials
- identify effective insulating materials.

5. Solar heating involves the absorption and transfer of energy from solar radiation.

Students will be expected to:

- describe general principles of passive and active solar heating (e.g., means of heat collection, storage and transfer of heat)
- identify functions of components used in a solar heating system
- design and construct a model solar heating device.

4. Electromagnetic Systems

OVERVIEW

The major emphasis of this unit is on science and technology. Opportunities are also provided to support learning regarding the nature of science and the relationship among science, technology and society.

This unit examines principles of current electricity that provide the basis for production, control and use of electrical energy. Principles of basic circuitry are introduced and these principles are applied in association with technological concepts of systems, subsystems and control. Extensive opportunities are provided for students to apply these concepts and principles to the solution of practical problems.

The study of electrochemical cells is included as part of this unit, thus providing a linkage to the unit Chemical Properties and Changes which follows.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of hazards in the use of electrical devices.
2. Awareness that practical problems can often be solved in multiple ways.
3. Confidence in personal ability to solve practical problems.
4. Respect for the diversity of approach exhibited by others in their search for solutions to practical problems.

SKILLS

Students will demonstrate the following technological problem-solving skills:

1. **Understanding the Problem**
   - **identifying the purpose**
   - **identifying specific requirements (specifications)**
2. **Developing a Plan**
   - **designing an electrical device that will accomplish a specific task through the controlled application of electrical energy**
   - **identifying alternative design solutions in the building of an electrical device**
3. **Carrying Out the Plan**
   - **testing the design**
     - **construction and testing of a simple electrical device**
     - **construction and testing of an electrical device that involves two or more subsystems**
   - **troubleshooting the design: identifying and correcting practical problems in an electrical device**
     - **identifying problems in design or construction of the circuit**
     - **identifying problems caused by materials or components used**
     - **improvising practical remedies for problems encountered**
     - **identifying potential hazards**
4. **Evaluating**
   - **evaluating the design**
     - **evaluating alternative designs for an electric battery**
     - **evaluating alternative designs for a simple electrical device**
   - **evaluating the planning process**

CONCEPTS

1. Current electricity is potentially dangerous.

   Students will be expected to:

   - assess the potential danger of an electrical device by referring to the voltage and amperage of the device
   - distinguish between devices that might be used safely in experimental studies and those that would not be appropriate
   - recognize dangerous procedures
   - recognize equipment that is in an unsafe condition for use.

2. Specialized technologies for the production of current electricity are based on chemical, photo-electric or thermo-electric principles.

Students will be expected to:

- describe the general design and function of a simple wet cell
- describe a process for testing the effectiveness of different materials for use within a wet cell
- describe the design of cells and batteries in common usage
- identify practical problems that designers of batteries have attempted to solve, and describe approaches that have been used to solve these problems (e.g., excessive size and weight, portability, durability)
- construct a thermocouple and demonstrate its effectiveness
- identify practical applications for which the use of photo-electric or thermo-electric devices are appropriate.

3. Electromagnetic effects provide a means for conversion of mechanical energy to electrical energy, or electrical energy to mechanical energy.

Students will be expected to:

- describe evidence of electromagnetic effects (e.g., electromagnetic effects caused by a current flowing through a wire)
- construct a simple galvanometer using a compass and wire
- use a meter to measure voltages and amperages within a circuit
- demonstrate the generation of electricity by movement of a magnet through a coil
- interpret the operation of a simple generator
- describe the design of a simple electric motor
- interpret the operation of an electric motor
- design and construct a device that operates on the basis of electromagnetic force (e.g., electromagnet, buzzer or motor).

4. Electrical devices are based on circuits.

Students will be expected to:

- construct a simple circuit using materials provided
- design and construct series and parallel circuits
- predict the effects of linking electrical loads in series and in parallel
- use materials provided to design a circuit that will perform a given function
- construct and interpret circuit diagrams
- identify short circuits in a sketch of a circuit or in an actual circuit.

5. Electrical resistance can be used to control the flow of electricity in a circuit or to produce heat and light.

Students will be expected to:

- construct and use a simple variable resistor using materials provided
- describe the effect of resistance on electron flow in a simple circuit
- predict the effects of resistors on electron flow in series and parallel circuits (based on placement of resistors at different locations in those circuits)
- interpret the design of devices that produce heat and light based on electrical resistance.

6. Electromechanical systems can be designed to perform simple or complex functions.

Students will be expected to:

- describe the operation of various kinds of switches and control devices (e.g., switches controlled by direct operator contact, timed switches, magnetically controlled switches, relays, diodes and transistors)
- use various kinds of switches and controls in a simple circuit
- design a circuit/construction that will perform a function then shut off when the function has been completed (e.g., a simple hoist which stops when a weight reaches a given height)
- design a circuit/construction that will perform one function and proceed to a second function when the first is completed (e.g., a hoist that automatically stops at a given height and switches on a light to signal that the function is complete)
- design a circuit/construction that will respond to a changing environmental condition (e.g., a device that responds to a change in temperature or light conditions)
- recognize systems and subsystems within household electromechanical devices (e.g., record players, electric washers)
- interpret the function and operation of electronic control devices in common domestic applications (e.g., thermostats, timers).

5. Chemical Properties and Changes

OVERVIEW

The major emphasis of this unit is on the nature of science. Opportunities are also provided to support learning regarding technologies and the relationship among science, technology and society.

This unit introduces the chemical properties of common substances. Students learn to distinguish between chemical and physical change and to recognize examples of chemical changes that occur in their environment. Factors that affect reaction rates are studied.

Particular focus is given to the chemistry of acids and bases.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of dangers in handling reactive chemicals.

2. Adoption of a prudent approach to the handling of all chemicals, especially those that are unfamiliar to the user.

3. Awareness of consistency in properties and reactions: recognition that chemical events can be viewed as predictable consequences of given conditions rather than as random or magical in occurrence.

SKILLS

Students will demonstrate the following science inquiry skills, with emphasis on those skills that appear in boldface:

1. **Questioning**

   - **recognizing patterns and discrepant events**
   - **identifying and asking pertinent questions**

2. **Proposing Ideas**

   - **hypothesizing relationships among observed chemical phenomena**
   - **predicting the nature and rate of chemical reactions**

3. **Designing Experiments**

   - **identifying variables that may affect reaction rates**
   - **developing experimental procedures:**
     - **for the safe handling of materials**
     - **for testing and observing physical and chemical properties**
     - **for testing and observing reaction rates**

4. **Gathering Data**

   - **observing physical and chemical properties of materials**
   - **identifying and describing distinctive features of particular chemicals**
   - **measuring**
     - **measuring physical properties of materials**
     - **measuring reaction rates**
     - **measuring pH**

5. **Processing Data**

   - **organizing and presenting data**
   - **recognizing patterns and trends in the properties of materials**

6. **Interpreting Data**

   - **inferring evidence of chemical reaction**
   - developing theoretical explanations

CONCEPTS

1. Materials have observable and measurable properties.

   Students will be expected to:

   - recognize that all materials have a chemical composition
   - identify and use appropriate safety procedures in the handling and observation of chemical materials
   - describe the crystalline structure of solid materials examined
   - measure the melting point of a solid
   - measure the density of a material by calculations based on mass and displacement
   - measure the solubility of a material
   - distinguish between chemicals that are relatively reactive and those which are not.

2. Changes in materials may be classified by reference to the properties of the materials that are affected.

Students will be expected to:

- distinguish between chemical and physical properties
- recognize and describe evidence of chemical change in materials (e.g., energy gains or losses, changes in physical properties)
- identify examples of physical change
- classify changes in materials as chemical or physical.

3. Acidity (pH) is a measurable characteristic of liquid solutions.

Students will be expected to:

- recognize hazards and safe procedures in the use of acids and bases, particularly in concentrated forms
- describe the effects of acid–base reactions
- describe the effects of acids and bases on other materials (e.g., on metals, glass and plastics)
- identify pH by use of various indicators
- identify the presence of acids and bases in household products.

4. Common household substances have physical and chemical properties.

Students will be expected to:

- identify chemicals commonly found in the home (e.g., in foods and in cleaning materials)
- describe the physical and chemical properties of some common household materials
- distinguish between different household materials on the basis of physical and chemical properties
- classify household chemicals according to their hazardous properties and appropriate conditions for storage
- recognize and interpret product safety symbols.

5. Rates of reaction are found to vary with the conditions of the reacting materials.

Students will be expected to:

- predict/describe effects of changing the concentration of materials on rates of reaction
- predict/describe effects of changing the size of particles on rates of reaction
- predict/describe effects of changing temperature on rates of reaction
- identify dangers of potentially explosive reactions
- observe and measure heat generated in chemical reactions.

6. Oxidation and corrosion reactions can be controlled by the use of chemical and physical means.

Students will be expected to:

- identify examples of oxidation and corrosion
- describe physical and chemical means of preventing corrosion
- evaluate means of preventing oxidation or corrosion in particular applications.

6. Environmental Quality

OVERVIEW

The major emphasis of this unit is on the relationship of science, technology and society. Opportunities are also provided to support learning regarding technologies and the nature of science.

In this unit, students are introduced to the idea of environmental quality and to the role of science in monitoring that quality. The central idea of the unit is that personal and public decision making regarding environmental quality is needed, and that the decision-making process should be informed by knowledge of environments and objective assessments of environmental impacts.

Extensive attention is given in this unit to human interventions within environments and the impacts of those interventions both in the short term and in the long term.

A variety of environmental quality indicators are considered. These include indicators of air, water and soil quality.

SPECIFIC LEARNER EXPECTATIONS

ATTITUDES

Students will be encouraged to develop:

1. Awareness of the effects that environmental quality has on the health and well-being of living things.
2. Awareness of impacts of human actions on environmental quality.
3. Awareness of the role of scientific knowledge in informing environmental decision making.
4. Recognition of limits in current knowledge regarding environments and appreciation of the difficulties that these limits can create for personal and public decision making.
5. Respect for the perspectives and viewpoints of others.
6. Concern for and commitment to the maintenance of environmental quality.

SKILLS

Students will demonstrate the following decision-making skills:

1. **Identifying issues and concerns regarding environmental quality.**
2. **Identifying alternatives regarding actions that may affect environments.**
3. **Researching**
   - **identifying and examining scientific information regarding potential alternatives**
   - **examining personal, social and environmental perspectives on each alternative**
   - **identifying consequences of each alternative**
4. **Reflecting and Deciding**
   - **considering alternatives**
   - **considering perspectives**
   - **building consensus**
5. **Taking Action**
   - **demonstrating responsibility through personal actions on the basis of evidence and scientific evaluation**
   - **demonstrating responsibility through actions as a member of a group**
6. **Evaluating**
   - **evaluating effects of actions**
   - **evaluating the decision-making process used**

CONCEPTS

1. Human actions modify environments through direct changes to living things, water, air and land; also through indirect effects.

   Students will be expected to:

   - describe examples of direct changes to environments that occur as a result of resource extraction, agriculture and/or human settlement
   - describe examples of changes to environments that occur as indirect consequences of human actions and lifestyles.

2. Environmental quality is used in reference to the ability of environments to be life supporting. A variety of biotic and abiotic factors are used as indicators of environmental quality.

   Students will be expected to:

   - identify abiotic factors in an environment that might affect the health and distribution of living things in that environment (e.g., available oxygen in water, presence of solids in air or water)
   - interpret the quality of an environment in terms of the variety of life forms it supports
   - describe effects of removal of selected species on other species that live in an environment (e.g., effect of removal of soil fauna on the quality of soil)
   - identify indicators of water quality (e.g., dissolved oxygen, presence of bacteria)
   - identify indicators of soil quality (e.g., depth of soil, aeration/compaction, presence of minerals)
   - identify indicators of air quality (e.g., presence of polluting gases, presence of particulates).

3. Pollutants are materials added to environments that negatively affect the quality of those environments.

   Students will be expected to:

   - identify household, municipal and industrial materials that comprise major sources of pollution in the local area
   - identify components within these wastes that have known negative effects
   - identify mechanisms by which these pollutants are added to the environment (e.g., direct application, transfer by leaching and water movement, atmospheric movements)
   - describe concentration of materials in micrograms per litre, milligrams per litre or in parts per million
   - describe procedures used in measuring the presence of a chemical material in an environment. (An example of local interest may be chosen.)

4. Materials added to an environment remain in that environment until they are moved or until they are converted to another form.

   Students will be expected to:

   - distinguish between wastes that are biodegradable in relatively short periods of time, and those that are not biodegradable
   - identify components of a waste product that can dissolve or be transported by water
   - describe the effect of ground and surface water movements on the distribution of materials, including pollutants
   - recognize waste disposal processes as involving one or more of the following processes: conversion of wastes, reintroduction of materials to the environments in original forms, and long term containment and storage
   - describe techniques used locally for disposal of a waste substance
   - identify points at which pollutants may enter food chains (particular emphasis on human foods).

5. Scientific knowledge contributes to the environmental decision-making process.

Students will be expected to:

- identify contributions of science to societal decision making regarding an environmental issue
- identify considerations, perspectives and trade-offs that contribute to the decision-making process (including scientific, environmental, economic, ethical, political and personal perspectives)
- identify alternative actions in response to an environmental issue and infer possible consequences of those actions
- identify consequences of inaction on environmental issues.

6. Decisions at the personal level affect environmental quality.

Students will be expected to:

- identify personal actions that can result in less waste production
- identify personal actions that help to assure that disposal of wastes occurs with minimal detrimental environmental impact
- identify personal actions that can contribute responsibly to societal action regarding an environmental issue.

D. LEARNING RESOURCES

BASIC LEARNING RESOURCES

GRADE SEVEN

Science Directions 7 by W.C. Durward et al. John Wiley and Sons/Arnold Publishing, 1989.

Science Directions 7 Teacher Resource Package by M. Amies et al. John Wiley and Sons/Arnold Publishing, 1989.

SciencePlus Technology and Society 7 by C.P. McFadden et al. Harcourt Brace Jovanovich, Canada, 1989.

SciencePlus Technology and Society 7 Teacher's Resource Book by C.P. McFadden et al. Harcourt Brace Jovanovich, Canada, 1989.

GRADE EIGHT

Science Directions 8 by W.C. Durward et al. John Wiley and Sons/Arnold Publishing, 1990.

Science Directions 8 Teacher Resource Package by M. Amies et al. John Wiley and Sons/Arnold Publishing, 1990.

SciencePlus Technology and Society 8 by C.P. McFadden et al. Harcourt Brace Jovanovich, Canada, 1990.

SciencePlus Technology and Society 8 Teacher's Resource Book by C.P. McFadden et al. Harcourt Brace Jovanovich, Canada, 1990.

GRADE NINE

Science Directions 9 by W.C. Durward et al. John Wiley and Sons/Arnold Publishing, 1990.

Science Directions 9 Teacher Resource Package by F. Borstmayer et al. John Wiley and Sons/Arnold Publishing, 1990.

SciencePlus Technology and Society 9 by C.P. McFadden et al. Harcourt Brace Jovanovich, Canada, 1990.

SciencePlus Technology and Society 9 Teacher's Resource Book by C.P. McFadden et al. Harcourt Brace Jovanovich, Canada, 1990.

SUPPORT LEARNING RESOURCES

Support learning resources are identified in the *Teacher Resource Manual.*

COMPUTER STUDIES

A. PROGRAM RATIONALE AND PHILOSOPHY

RATIONALE

In 1985, the *Secondary Education in Alberta* Policy Statement stated that:

> "Growing demands are placed on secondary schools to provide for the educational needs of all students. Access to better educational opportunities is possible by integrating advances in technology such as computer networking, electronic communications, and other new developments in distance education and individualized learning. The application of technology in the classroom to enhance learning will require a collective vision and cooperation among many community agencies involved in the delivery of secondary education programs. Finally, students must understand the concept, the potential impact and the use of technology."

and

> "The secondary education system must use technology to enhance learning and to facilitate access to equitable educational opportunities for all students, regardless of ability, circumstance or location."

Students should be able to use computer technology to enhance their learning and to gain access to educational opportunities throughout their lives. To this end, **the computer studies complementary program will promote the integration of computers into student learning.** The program is based on two beliefs: first, all students need to have some minimal knowledge of computers, particularly from the point of view of the computer as a productivity tool and learning tool (learning with and through computers); second, students who wish to pursue their study in this area have the opportunity to participate in a complementary computer studies program (learning about computers).

PHILOSOPHY

The philosophy of this program is based on the following major principles:

- Students should be able to use computer technology to enhance their learning in all subject areas and to gain access to educational opportunities.
- A computer studies program should provide flexibility in accommodating the needs of students and should recognize the technical and human resources available for program implementation.
- A computer studies program should accommodate students with varying experiences and entry skills.
- A computer studies program should accommodate the needs of schools at "early" and "mature" stages of computer integration into other subject areas.

This computer studies program is flexible to accommodate schools with varying facilities, stages of computer integration and teacher expertise, and students with varying entry levels of skills and experience. Students have the right not to repeat learner expectations already mastered.

To be consistent with the philosophy of this program, teachers should teach toward more than one set of learner expectations with more than one group of students at the same time.

B. GENERAL LEARNER EXPECTATIONS

Students will:

- demonstrate an ability and willingness to use computer technology as a learning and productivity tool in this program and in other subject areas
- demonstrate an understanding of the power and limitation of computer technology
- demonstrate an understanding and appreciation of the impact that computer technology has on their lives, on their community and on society
- pursue personal interests in computer technology while recognizing appropriate applications in the home and workplace.

Specific Learner Expectations

Specific learner expectations have been identified for each module in the statement of Content which follows.

C. CONTENT

1. PROGRAM FRAMEWORK

The Junior High Computer Studies Program is a three-year program divided into five themes:

THEME 1: Applications

The applications theme provides students with an introduction to computers, how computers operate, and an overview of computer software. Other modules in this theme provide an opportunity to use computers for desktop publishing.

THEME 2: Keyboarding

Keyboarding is the process of entering (keying and inputting) data into the computer through the use of a keyboard. This theme develops students' keyboarding skills so that personal comfort and keyboarding productivity is enhanced when using computers.

THEME 3: Productivity

Computers are considered to be a powerful aid to mental activities and the dissemination of the results of these mental activities. This theme introduces the student to the effective use of the productivity tools of word processing, data bases, spreadsheets, graphics and electro-communications in other subject areas.

THEME 4: Programming

Computers need instructions to complete tasks; that is, what to do and when to do it. This theme provides students with an introduction to creating lists of instructions, called "programming". Programming topics in the theme include programming languages, custom programming and advanced programming.

THEME 5: Society

As a tool of an information-based society, computers play a significant role. This theme introduces the student to the impact of computers on society through issue identification, trend identification, historical developments, artificial intelligence and robotics.

Each theme contains five modules, for a total of 25. Six of these 25 modules have been designated as **mandatory**; that is, these six modules represent the **minimum requirements** of the first year of the program. They are:

Module 1: Computer Operations
Module 6: Keyboarding – Introduction
Module 7: Keyboarding – Full Keyboard
Module 11: Word Processing – Introduction
Module 16: Programming – Introduction
Module 21: Societal Issues – Introduction

All learner expectations from these mandatory modules must be achieved before students proceed to other modules.

All modules, except Module 1, have been designed to be completed in six to twelve hours of instructional time. Module 1 has been designed to be completed in four to six hours. Completion of the six mandatory modules is intended to require 75 hours of class time with the opportunity built in for enrichment or remediation to meet the individual needs of students.

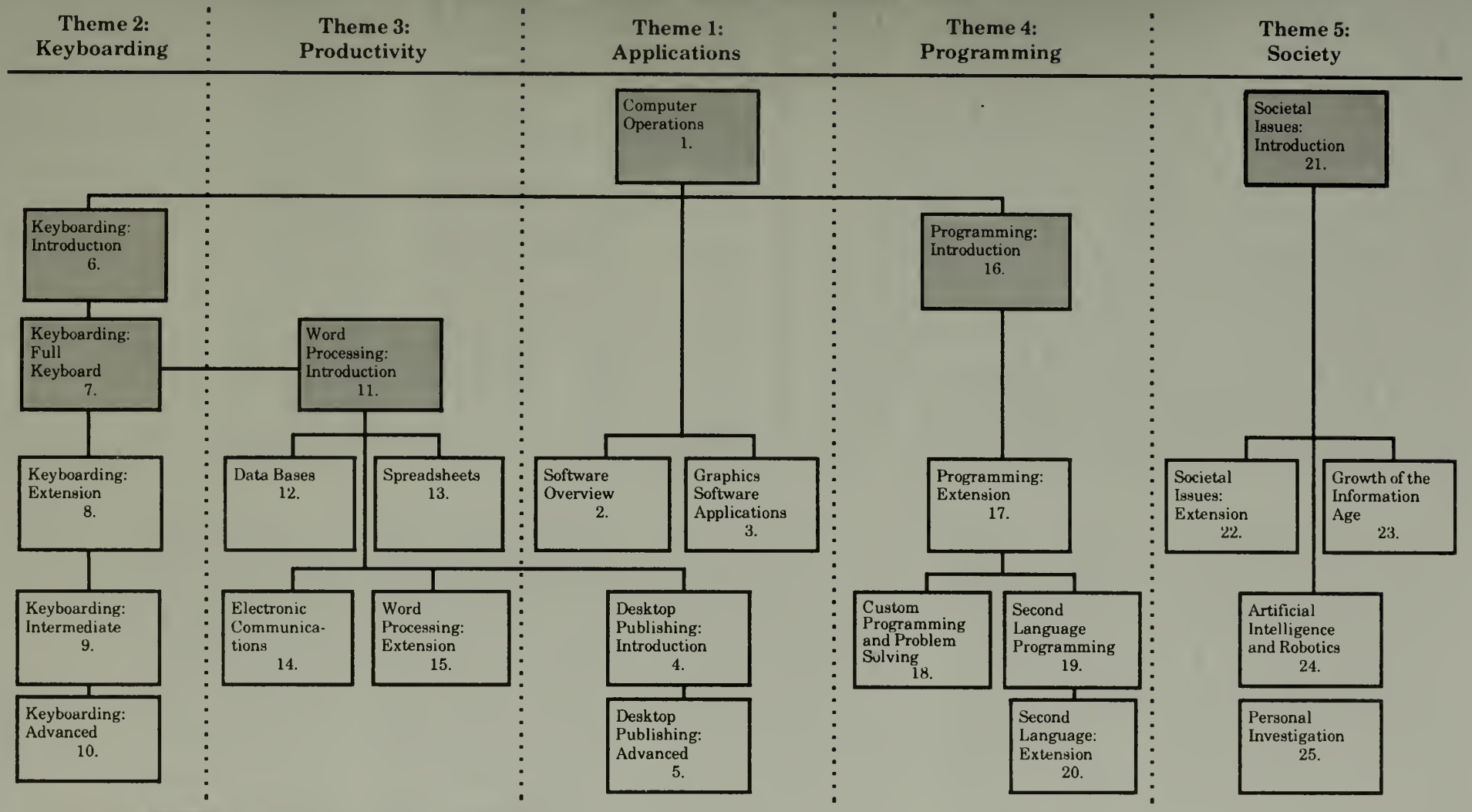
Some modules have been identified as **prerequisite** modules, and a student should proceed in a sequence that takes prerequisite modules into account. Such a sequence is intended to be followed in order to reduce the adjustment problems students may encounter, as well as to increase the carry over from one module or theme to another. The prerequisite modules should provide students with required skills, understandings or information for subsequent study. Prerequisite modules are identified as such in the specific learner expectations.

It should be noted that during the second and third year of the program, students must take one module from the keyboarding theme and a minimum of four modules from three other themes, for a minimum of five modules per year. It is intended that keyboarding instruction and practice be presented and carried out on a continual basis.

Although the program contains materials sufficient for a three-year program, it may be offered as a one-, two- or three-year program depending on student needs, school facilities and available computer software. The program is flexible and can be adapted to a wide variety of situations from schools just beginning to use computers to schools using computers extensively.

The content of the program can be summarized by the following chart. The shaded areas represent the mandatory modules of the program.

FLOW CHART OF COMPUTER STUDIES MODULES



Note: • = mandatory modules; the minimum requirements for the first year of the program.

• during the second and third year of the program, students must take one module from the Keyboarding theme and a minimum of four modules from three other themes for a minimum of five modules per year.

2. PROGRAM FLEXIBILITY

In keeping with the intent of junior high complementary courses as exploratory courses of choice for students, the computer studies program is designed to meet the needs of students with varying entry levels of skills and experience. The six mandatory modules provide an introductory experience for students with limited background; the remaining nineteen modules are designed for students who have met the requirements of the mandatory modules and wish to extend their learning.

Since the computer studies program may involve students for one, two, or three years of study, initial emphasis is placed on using the microcomputer to support instruction and learning (rather than on a study of the machine itself). Students operating on a one-year study at this level would concentrate on meeting the learner expectations identified in the mandatory modules.

This program has been designed in a modular format in order to enhance program flexibility and to ensure that students entering the program can be placed appropriately. Students should have as much flexibility as possible to enter their study at a level consistent with their knowledge and ability. Teachers assessing student competency will be able to place students according to the specific learner expectations listed for each module. Three typical examples are outlined below.

Student A entering the computer studies complementary program with little or limited computer familiarity would be expected to complete the six mandatory modules. Modules 1 and 6 are also identified as being prerequisite for study of other modules and should be completed first. In a second or third year of study, this same student would be expected to complete at least one module from the keyboarding theme and a minimum of four modules from three other themes, for a minimum of five modules per year.

Student B entering the computer studies program with enough background to consider that the requirements for a number (e.g., 3 or 4) of the mandatory modules are completed, would follow a slightly different pattern from Student A. This student would be expected to complete those mandatory modules remaining and then would explore modules from additional themes, keeping in mind the requirement of one module from the keyboarding theme and a minimum of four modules from three other themes for a minimum of five modules per year. In the second or third year of study, Student B would be expected to complete at least one module from the keyboarding theme and a minimum of four modules from three other themes, for a minimum of five modules per year.

Student C entering the computer studies program with enough experience and knowledge to consider the mandatory modules already completed would proceed to more advanced modules, keeping the prerequisite modules in mind. Thus, regardless of "grade level", during the first year Student C would complete other modules as determined by minimum program requirements. During a second or third year, this student would be expected to complete one module from the keyboarding theme and a minimum of four modules from three other themes, for a minimum of five modules per year.

Strategies for assessing student entry levels and for tracking student progress are identified in the *Teacher Resource Manual.*

3. REQUIRED/ELECTIVE COMPONENTS

Each module of the program has a required component and an elective component, defined as follows.

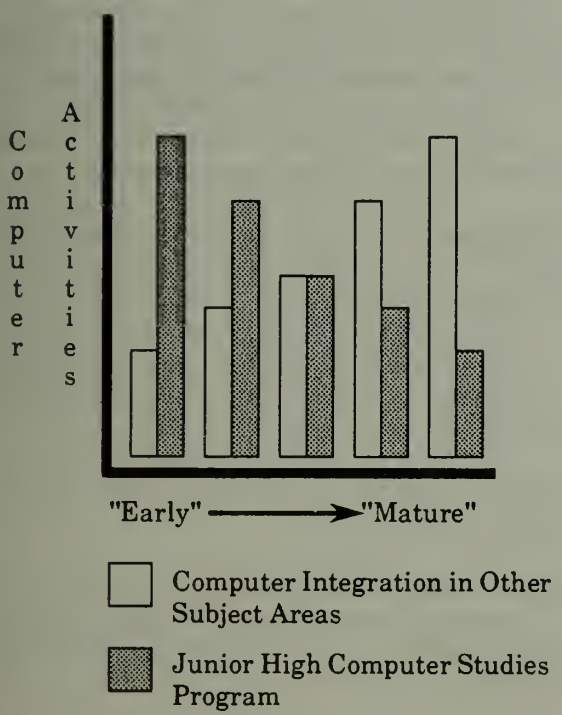
> The **required** component encompasses the knowledge, skills and attitudes that all students should be expected to acquire.
>
> The **elective** component provides opportunities to adapt and enhance instruction to meet the diverse needs, abilities and interests of individual students. It provides enrichment and additional assistance to individual students as necessary.

Completion of the six mandatory modules is expected to take 75 hours of class time. This includes elective time which provides the opportunity for enrichment or additional assistance to meet the individual needs of students for 30 percent of the instructional time.

4. INTEGRATION IN OTHER SUBJECT AREAS

This program will provide an opportunity for junior high students to explore computer studies in a complementary program. It has been designed as a bridge to encourage integration into other subject areas as schools move from "early" to "mature" stages of integration. Schools at an "early" stage of implementation place an emphasis on the computer studies complementary program with computers taught only as a separate subject. There is little, if any, integration of computers in core programs. Schools at a "mature" stage of implementation place a primary emphasis on the integration of the computer in core and complementary programs/courses. The computer studies program is available to those students wishing to pursue in-depth studies about the computer.

STAGES OF
COMPUTER INTEGRATION
IN OTHER SUBJECT AREAS



Specific learner expectations achieved in many modules in this program can be applied directly in other subject areas.

As schools move toward increased integration (or as the competence level of the students develops), the Junior High Computer Studies Program emphases should shift from learning with and through computers to learning about computers.

5. SPECIFIC LEARNER EXPECTATIONS

A list of modules, by theme, identifying specific learner expectations, follows. Please note those modules that are mandatory and those that are prerequisite.

These specific learner expectations are the concepts, skills and attitudes that students will develop in each of the modules in the five themes of the program.

THEME 1: APPLICATIONS

MODULE 1: Computer Operations (Mandatory)

This module is an introductory module for those students unfamiliar with the components and operation of a microcomputer system. It is intended to be completed by beginning students in four to six hours.

Prerequisite Module – None

Specific Learner Expectations

Students will:

1. Exhibit confidence and interest in the use of computer technology.

2. Demonstrate how a computer system operates by:

    a. using a computer tutorial disk
    b. using computer terminology (monitor, disk drive, central processing unit, keyboard, mouse, disk, load, catalogue)
    c. explaining the relationship between hardware and software
    d. using various parts of a computer system (printer, disk drives, keyboard, monitor, mouse)
    e. using a pull-down menu and/or function keys
    f. using special keys (control, escape, delete).

3. Demonstrate an understanding of a disk operating system such as DOS, ProDos, MS-DOS by:

    a. explaining the purpose of a system master
    b. loading and cataloguing disks
    c. formatting and initializing disks
    d. recognizing the incompatibility between systems.

4. Demonstrate understanding and use of different types of memory (RAM/ROM, ram card).

5. Demonstrate responsible behaviour in using computer technology by the proper handling of hardware and software.

MODULE 2: Software Overview

This module introduces students to a variety of commercially prepared software as a means of increasing student awareness of the scope and usefulness of microcomputers.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use a wide range of commercially prepared software to:

    a. identify the variations of software types and their main purposes (drill and practise, tutorial, simulations, problem solving) through the use of an example or sample of each
    b. understand the differences among menu-driven software, memory resident software, multiple access (return to the disk often) software, by the use of an example of each
    c. configure software for different disk drive set-ups and/or different printer set-ups (interface selection, slot identification)
    d. independently follow documentation to make "unfamiliar" software operational.

2. Distinguish the appropriate use of software by:

    a. analyzing given situations or tasks and be able to apply appropriate software
    b. interacting with software in order to solve a problem or deal appropriately with a given task.

3. Explain the difference between copyright and public domain software.

4. Assess software based on general (e.g., ease of use, accurate content, clear directions, graphic displays, colour, sound, error free) and personal criteria.

MODULE 3: Graphics Software Applications

This module introduces students to a variety of commercially prepared software as a means of increasing and improving a student's personal productivity.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Demonstrate familiarity with a variety of graphics software by completing a number of assignments that make use of the specific applications of individual software packages (signs, invitations, certificates, draw features).

2. Use appropriate graphics software to solve a problem or deal appropriately with a given task.

3. Interpret potential benefits arising from the use of graphics software.

4. Use manuals to learn the operation of graphics software and to correct minor problems that may arise.

5. Use appropriate graphics software to complete assignments in other subject areas.

6. Use appropriate graphics software to produce useful items for the school (signs or advertisements).

7. Assess graphics software based on general (e.g., ease of use, clear directions, graphic displays, colour, error free) and personal criteria.

MODULE 4: Desktop Publishing – Introduction

This module introduces students to the use of a desktop publishing program that will allow students to layout and design graphics and text in a short document.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use appropriate desktop publishing vocabulary (scroll bars, import graphics, place text, snap to guides, clip art, text area, graphic area, header, footer).

2. Describe standard rules of design and layout (proportion, balance, rhythm, unity, contrast).

3. Use a desktop publishing software package to:

   a. design and lay out a one-page document with two or more columns per page
   b. understand and demonstrate necessary steps to place text and import graphics
   c. change font and sizes.

4. Use pre-designed templates to create a newsletter, brochure, invitation, résumé or personalized stationery (where software permits).

5. Describe how this technology is used in the world of business.

6. Identify the differences between desktop publishing and word processing.

7. Demonstrate elementary principles of graphic layout and design by producing a one-page document to complete assignments in another subject area or for the school.

MODULE 5: Desktop Publishing - Advanced

This module expands students' use of a desktop publishing program so they can produce a multi-page document.

Prerequisite Module – Module 4: Desktop Publishing – Introduction

Specific Learner Expectations

Students will:

1. Apply advanced techniques of desktop publishing by:
   a. designing a multi-page document with two or more columns per page
   b. changing fonts, sizes and alignment of text
   c. using draw features to enhance clip art graphics or text areas
   d. using cut, copy and paste features to manipulate graphics and text
   e. using additional features of specific desktop publishing packages (kerning, leading, flow text, thesaurus, spelling dictionary).
2. Assess desktop publishing software and the multi-page document based on general (e.g., ease of use, screen displays, technical design, useful features) and personal criteria.
3. Investigate an area of individual interest from another subject area(s) through independent planning, teacher-assisted planning or selecting a topic from teacher-prepared options to produce a multi-page document.

THEME 2: KEYBOARDING

MODULE 6: Keyboarding - Introduction (Mandatory)

This module introduces students to correct touch-typing techniques.

Prerequisite Module – Module 1: Computer Operations

Specific Learner Expectations

Students will:

1. Develop and demonstrate correct technique:
   a. posture (hand, arm, body)
   b. fingering
   c. stroking.
2. Locate and properly use the alphabetic keys, space bar, shift keys and return key.
3. Develop touch-typing skills.
4. Develop the ability to recognize typographical errors.

MODULE 7: Keyboarding – Full Keyboard (Mandatory)

This module continues the skill development of touch-typing, with emphasis on increased stroking and accuracy rates.

Prerequisite Module – Module 6: Keyboarding – Introduction

Specific Learner Expectations

Students will:

1. Continue to develop and demonstrate correct technique:
   a. posture (hand, arm, body)
   b. fingering
   c. stroking.
2. Locate and properly use all alphabetic keys, numeric keys, space bar, shift keys, return key and other necessary function keys.
3. Continue developing touch-typing skills.
4. Continue to develop the ability to recognize and mark typographical errors.
5. Use correct spacing after punctuation.
6. Calculate words-a-minute (W.A.M.) on straight copy for a one minute timing on:
   a. personal handwriting
   b. keyboarding.
7. Complete a one minute timing with keyboarding speed equal to personal handwriting speed.

MODULE 8: Keyboarding – Extension

This module continues the skill development of touch-typing, with emphasis on the use of alphabetic and numeric keys, with increased stroking and accuracy rates.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Continue to develop and demonstrate correct technique:
   a. posture (hand, arm, body)
   b. fingering
   c. stroking.
2. Locate and properly use all alphabetic keys, numeric keys, space bar, shift keys, return key and other necessary function keys.
3. Locate and properly use special character keys ($, %, &).
4. Continue developing touch-typing skills, using both alphabetic and numeric keys.
5. Continue to develop the ability to recognize and mark typographical errors.
6. Use correct spacing after punctuation.
7. Calculate words-a-minute (W.A.M.) on straight copy.
8. Complete a one minute timing with keyboarding speed equal to or greater than personal handwriting speed.

MODULE 9: Keyboarding - Intermediate

This module continues the skill development of touch-typing, with emphasis on the use of the full keyboard and increased stroking and accuracy rates.

Prerequisite Module – Module 8: Keyboarding – Extension

Specific Learner Expectations

Students will:

1. Continue to develop and demonstrate correct technique:
   a. posture (hand, arm, body)
   b. fingering
   c. stroking.
2. Locate and properly use all alphabetic keys, numeric keys, space bar, shift keys, return key and other necessary function keys.
3. Locate and properly use special character keys ($, %, &), as required.
4. Continue to develop touch-typing skills, using both alphabetic and numeric keys.
5. Continue to develop the ability to recognize and mark typographical errors.
6. Use correct spacing after punctuation.
7. Calculate words-a-minute (W.A.M.) on straight copy.
8. Complete a two minute timing with keyboarding speed equal to or greater than personal handwriting speed.

MODULE 10: Keyboarding - Advanced

This module continues the skill development of touch-typing, with emphasis on the use of the full keyboard and increased stroking and accuracy rates.

Prerequisite Module – Module 9: Keyboarding – Intermediate

Specific Learner Expectations

Students will:

1. Continue to develop and demonstrate correct technique:
   a. posture (hand, arm, body)
   b. fingering
   c. stroking.
2. Locate and properly use all alphabetic keys, numeric keys, space bar, shift keys, return key and other necessary function keys.
3. Locate and properly use special character keys ($, %, &), as required.
4. Continue to develop touch-typing skills, using both alphabetic and numeric keys.
5. Continue to develop the ability to recognize and mark typographical errors.
6. Use correct spacing after punctuation.
7. Calculate words-a-minute (W.A.M.) on straight copy.
8. Complete a three minute timing with keyboarding speed equal to or greater than twice the personal handwriting speed.

THEME 3: PRODUCTIVITY

MODULE 11: Word Processing – Introduction (Mandatory)

This module introduces students to the operation of word processing software.

Prerequisite Module –Module 7: Keyboarding – Full Keyboard

Specific Learner Expectations

Students will:

1. Demonstrate effective use of word processing in the stages of the writing process.
2. Use word processing vocabulary (file, document, word wrap, cursor, scrolling, screen display).
3. Recognize the basic concepts of word processing.
4. Explain the advantages of a word processor (on-screen editing, speed).
5. Describe the differences between a stand-alone word processor computer and a computer with a word processing software package.
6. Understand and demonstrate the steps necessary to use the basic functions of a word processing package (create, store, retrieve, edit, print, list files, move/copy text, search/replace text).
7. Output documents to the screen and printer.
8. Apply keyboarding skills.
9. Complete an assignment in another subject area, using a word processing software program.

MODULE 12: Data Bases

This module introduces students to the electronic filing of data, using a data base software program.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use the vocabulary of data base construction (category, field, record, file, search rules, arranging data, layout, single record, multiple record, hard copy).
2. Recognize the basic concepts of a physical data base, as opposed to an electronic data base (telephone or postal code directories, automotive parts book).
3. Explain the advantages of an electronic data base (speed, consistency, adaptability, accessibility and variability).
4. Identify primary features of data base software (structuring of a data base, entering data, storing data, arranging data, searching and retrieving data).
5. Create report files and printouts to printer or display on screen, using a sort procedure.
6. Produce a hard copy data report using single and/or multiple record layouts.
7. Develop understanding of the wide variety of applications for data base information.
8. Assess data base software based on general (e.g., ease of use, clear directions, graphic displays, useful features) and personal criteria.
9. Integrate data base and word processing files to produce a document (where software permits).
10. Develop skills of data input through appropriate review and practise of keyboarding skills.
11. Create a new data base designed to provide solutions to specific applications in another subject area.

MODULE 13: Spreadsheets

This module introduces students to the electronic ledger sheet, using a spreadsheet software program.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use the vocabulary of spreadsheet construction (cells, rows, columns, coordinates, categories, labels, values, blocks, formulas, functions, windows).
2. Recognize the basic concepts of a spreadsheet in working with numbers in rows and columns and using calculation techniques to forecast the effects of changes.
3. Explain the advantages of an electronic spreadsheet (speed, accuracy, adaptability, accessibility and variability).
4. Identify primary features of spreadsheet software (calculating and recalculating, formulas, functions, formatting).
5. Set up a spreadsheet (layout and calculations) to produce predicted results.
6. Output report files to the screen and printer.
7. Develop understanding of the wide variety of applications of spreadsheet information.
8. Assess spreadsheet software based on general (e.g., ease of use, clear directions, graphic displays, useful features) and personal criteria.
9. Integrate spreadsheet and word processing files to produce a document (where software permits).
10. Develop skills of data input through appropriate review and practise of keyboarding skills.
11. Create a new spreadsheet (layout and formulas) designed to provide solutions to specific problems in another subject area.

MODULE 14: Electronic Communications

This module introduces students to communications software as well as to the broad spectrum of electronic communications.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use the vocabulary and concepts of electronic communications (baud rate modulate/demodulate, binary, analog, digital data transmission, electronic messaging, networking, on-line, logon, logoff, password, access code, electronic data base, down-load, up-load).
2. Recognize the basic concepts of electronic communication.
3. Identify the advantages/disadvantages of electronic communications.
4. Identify a wide variety of electronic communications devices and services (e.g., pocket pagers, cellular telephones, teleshopping services, fax transmission, teleconferencing, networking).
5. Calculate the potential cost of electronic communications with computers (e.g., telephone hook-up, long distance charges, membership to messaging services and/or data banks).
6. Explain the function of a modem.
7. Demonstrate correct operation of a modem.
8. Demonstrate the ability to send and receive electronic mail.
9. Demonstrate the ability to access a remote data bank to search for specific information.
10. Demonstrate the ability to search a remote data bank, using electronic communications to complete a research assignment for another subject area.

THEME 4: PROGRAMMING

MODULE 15: Word Processing – Extension

This module expands the students' knowledge of and familiarity with the operation of a word processor.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use standard formatting rules by:
   a. identifying and demonstrating the proper use of format functions (tabs, margins, hanging indentations)
   b. changing document format (adjusting margins, line format, tab settings and page formats).
2. Use block functions (cut and paste, delete, move, copy).
3. Produce class assignments (e.g., letters, lists, compositions and/or assignments from other subject areas).
4. Assess word processing software based on general and personal criteria.
5. Use desktop accessories (e.g., spell checker, grammar checker, thesaurus) to correct errors.
6. Identify the advantages/disadvantages of spell checker and/or grammar checker software.
7. Integrate word processing documents with spreadsheets, data bases and/or graphics to produce a document (where software permits).
8. Investigate an area of personal interest from another subject area(s) through independent planning, teacher-assisted planning or selecting a topic from teacher-prepared options to produce a multi-page document.

MODULE 16: Programming – Introduction (Mandatory)

This module provides the opportunity for students to explore the possibilities of controlling the computer by programming.

Prerequisite Module – Module 1: Computer Operations

Specific Learner Expectations

Students will:

1. Demonstrate understanding of computer programming in BASIC by:
   a. planning, designing and operating simple programs using commands (NEW, HOME, PRINT, RUN, FLASH, INVERSE, NORMAL, LIST, REM, TAB, HTAB, VTAB, GOTO, END, SAVE)
   b. coding, running and documenting programs (REM statements)
   c. outputting to disk, screen and printer
   d. editing and "debugging" simple programs (both student-generated and other)
   e. using arithmetic symbols to solve problems
   f. drawing simple lo-res pictures (program or drawing programs).

And/Or

Demonstrate understanding of computer programming in Logo by:

   a. designing and operating simple procedures, using commands (FORWARD, BACK, RIGHT, LEFT, HOME, SHOWTURTLE, PENUP, PENDOWN, PENERASE, SETC, SETBG)
   b. coding and operating programs, using proper syntax
   c. outputting to disk, screen and printer
   d. editing and debugging simple programs (both student and other).

And/Or

Demonstrate understanding of computer programming in another programming language (e.g., Pascal, Machine, Hyper Media).

MODULE 17: Programming - Extension

This module allows students to explore more complex programming concepts and procedures.

Prerequisite Module - All Mandatory Modules

Specific Learner Expectations

Students will:

1. Program increasingly complex routines in BASIC by:

    a. using programming vocabulary (GOSUB/RETURN, READ/DATA, FOR-NEXT with both positive and negative steps, timing loops, numeric/string variables, INPUT, LET, IF-THEN)
    b. planning programs with flow charts, using branches, subroutines, editing and "debugging"
    c. writing structured programs to provide problem solutions
    d. identifying the differences and similarities between lo-res and hi-res graphics
    e. drawing simple hi-res pictures (program or drawing programs)
    f. designing programs that will use both lo-res and hi-res graphics.

And/Or

Program increasingly complex routines in Logo by:

    a. learning programming vocabulary (REPEAT, Recursion)
    b. using Logo arithmetic commands to make calculations
    c. using a procedure that calls itself a subprocedure (Recursion) to create interesting patterns
    d. developing a superprocedure (make the turtle draw the entire shape) for more complex shapes
    e. using Logo in problem solving.

And/Or

Program increasingly complex routines in another programming language (e.g., Pascal, Machine, Hyper Media).

MODULE 18: Custom Programming and Problem Solving

This module provides students with the opportunity to further develop their programming skills.

Prerequisite Module - Module 17: Programming - Extension

Specific Learner Expectations

Students will:

1. Design and operate programs through advanced programming techniques in BASIC by:

    a. using programming vocabulary (RND, INT, Array, LEFT$, MID$, RIGHT$, LEN$, PEEK, POKE, CALL)
    b. designing and operating programs incorporating advanced programming techniques for problem solving (e.g., sports statistics, hockey pools, personal inventories, title pages, marks processing)
    c. using graphic techniques and capabilities to enhance programs
    d. using advanced graphics for animation of objects (moving objects, backgrounds).

And/Or

Design and operate procedures through advanced programming techniques in Logo by:

    a. using programming vocabulary (RANDOM, BUTFIRST, BUTLAST, EMPTY?, EQUAL?, IDENTICAL?, LPUT, PARSE, TEXTLEN, TEXTPOS)
    b. designing and operating procedures incorporating advanced programming techniques for problem solving (e.g., animation, music, textual presentation)
    c. using a combination of advanced programming techniques for demonstrating principles from other subject areas
    d. controlling graphic sprites in a spatial environment to solve problems from other subject areas (e.g., graph linear functions, area problems).

And/Or

Design and operate programs through advanced programming techniques in another programming language (e.g., Pascal, Machine, Hyper Media).

2. Evaluate personal programs recognizing their potential and limitations.

3. Develop instructions for a moderately complex program.

MODULE 19: Second Language Programming

This module provides students with the opportunity to develop their programming skills in a second programming language.

Prerequisite Module – Module 17: Programming – Extension

Specific Learner Expectations

Students will:

1. Demonstrate an understanding of computer programming in a second language (e.g., Logo, BASIC, Pascal, Machine, Hyper Media) by:
   a. using the vocabulary and commands required
   b. using the hardware, software, print material specifications required
   c. establishing the correct syntax and/or structure for the language.
2. Compare advantages/disadvantages of the second language to BASIC or Logo.
3. Use appropriate editing steps to modify and/or correct procedures.
4. Develop formatting skills to provide hard copy output.

MODULE 20: Second Language – Extension

This module provides students with the opportunity to further develop their programming skills in a second programming language.

Prerequisite Module – Module 19: Second Language Programming

Specific Learner Expectations

Students will:

1. Use advanced techniques and concepts related to the use of the second computer language and its application to problem-solving situations.
2. Use correct commands and syntax.
3. Demonstrate editing, "debugging" and recoding techniques using advanced language instructions.
4. Use advanced applications of a second language in a variety of problem-solving situations.
5. Identify specific uses of the second language program.
6. Design and operate a user-friendly program in a second language.
7. Use proper documentation techniques suitable to the language (e.g., using REM statements in BASIC).

THEME 5: SOCIETY

MODULE 21: Societal Issues – Introduction (Mandatory)

This module introduces students to issues and concerns resulting from the impact of computer technology on the individual and society.

Prerequisite Module – None

Specific Learner Expectations

Students will:

1. List personal uses of computer technology in daily activities.

2. Identify benefits and limitations of computer technology.

3. Analyze the need for the protection of privacy regarding storage of personal data by researching human rights issues (e.g., privacy of the individual, freedom of information).

4. Understand the ethical use of computers by:

   a. demonstrating awareness of present copyright laws
   b. recognizing practices that are an infringement of present copyright laws
   c. listing safeguards that have been developed to prevent unethical use of computers
   d. identifying concerns relating to computer crime (e.g., trojans, viruses, worms and hackers).

5. Develop an awareness of areas in which computers are playing an important role by researching issues dealing with the projected use of computers (e.g., areas of society such as government, commerce and architecture; entertainment, art and literature; libraries; handicapped devices, medical and health care systems; home appliances, games and automobiles).

MODULE 22: Societal Issues – Extension

This module provides students with an opportunity to expand the issues from Module 21 to the application of computer technology in the home and workplace.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Project future job trends in terms of career planning and the changing job market by identifying jobs that are presently performed by:

   a. robots and/or computers
   b. people working with computers
   c. people whose jobs may eventually be replaced by computers
   d. people whose jobs cannot be replaced by computers
   e. people whose jobs were created because of computers.

2. Analyze the issue of the implementation of computer technology versus human needs by:

   a. listing criteria an employer would follow in choosing whether or not to use computer technology in the workplace (e.g., the issue of health and safety)
   b. comparing the moral implications of job creation/loss to the profit motives of business
   c. identifying alternatives for employees whose jobs may be changed due to computer technology.

3. Identify and project changes in traditional and non-traditional male/female occupations using computer technology.

MODULE 23: Growth of the Information Age

This module introduces students to the growth of the information age from a historical and a technical viewpoint.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Develop an understanding of the historical beginnings of computer technology by:

    a. describing the early methods of representation and manipulation of information by mechanical or electronic means
    b. researching the developments leading to 1st generation computers
    c. using historical vocabulary (abacus, Hollerith card, tabulation, digital, electro-mechanical, vacuum tubes, transistors)
    d. summarizing the historical growth of computers from the 1st to the 5th generation.

2. Examine the interrelationship between society and the historical development of the computer.

3. Develop an understanding of computer technological changes by:

    a. using 5th generation vocabulary (cryogenics, fiber optics, optical light circuits, parallel processing)
    b. identifying the effect of technological innovation on computing power
    c. predicting future technological innovations.

MODULE 24: Artificial Intelligence and Robotics

This module provides opportunities for students to explore artificial intelligence and robotics.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Use a computer software package that illustrates artificial intelligence and/or an expert system.

2. Report on the most current developments in the field of artificial intelligence and/or robotics.

3. List the advantages/disadvantages of robotics in the home and workplace.

4. Investigate the construction and operation of industrial and personal robots (e.g., home robot kits, factory machines, space robots, artificial limbs and devices for handicapped persons).

5. Describe the development of supercomputers and expert systems.

6. Identify the advances made in 5th generation computers in highly industrialized societies.

MODULE 25: Personal Investigation

This module provides students with the opportunity for a personal inquiry into an aspect of computer technology of their own choice.

Prerequisite Module – All Mandatory Modules

Specific Learner Expectations

Students will:

1. Investigate an area of personal interest through independent planning, teacher-assisted planning, or selecting a topic from teacher-prepared options (e.g., integration of the computer in the school).

2. Present or demonstrate the results of the personal investigation.

D. LEARNING RESOURCES

BASIC LEARNING RESOURCES

AppleWorks
Version 3.0
Claris Corporation, 1989.
Note: This computer software program is available for purchase from the Learning Resources Distributing Centre.

FrEdWriter
Version 4.4
San Diego County Office of Education, 1987.
Note: This computer software program is available for purchase from the Learning Resources Distributing Centre.

LogoWriter Secondary
Version 2.0
Logo Computer Systems Inc., 1989.
Note: This computer software program is available for purchase from the Learning Resources Distributing Centre.

Microsoft Works
Version 2.0 (IBM), 1989
Version 2.0a (Macintosh), 1988
Microsoft Corporation.
Note: These computer software programs are available for purchase from the Learning Resources Distributing Centre.

MouseWrite
Version 2.6.8c
Roger Wagner Publishing Inc., 1985-87.
Note: A copy was distributed free of charge to each school jurisdiction; school jurisdictions may duplicate as desired.

SUPPORT LEARNING RESOURCES

Support learning resources are identified in the *Teacher Resource Manual.*

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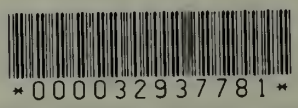

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